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Insecticide Tests for Control of the Sugarbeet Root Maggot, 1968–78

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Insecticide Tests for Control of the Sugarbeet Root Maggot, 1968–78

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U.S. Department of Agriculture
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ABSTRACT

Insecticidal tests conducted against the sugarbeet root maggot, *Tetanops myopaeformis* (Röder), in southern Idaho over an 11-year period are summarized. Efforts to prevent maggot damage to roots by killing adult flies with sprays and insecticide treated stakes were not as effective as soil treatments directed at maggots. Insecticides applied under sprinkler irrigation were generally more effective than when applied under furrow irrigation.

Shanking or injecting insecticides into the soil generally gave better maggot control than applications banded over the row, but the reverse was true in terms of yield. This is attributed to mechanical plant damage due to shanking. The relative phytotoxicity of insecticides registered for use is presented, and evidence of phytotoxicity, mechanical damage, or both was found in 10 of our tests. Insecticide applications, then, in the absence of damaging root maggot populations may decrease yields. We found that insecticides can be applied effectively after potential damage has been assessed by monitoring fly populations with sticky stake traps.

Tentative economic threshold levels are given for aldicarb, carbofuran, and phorate for conditions of varying expected beet yields and dollar return per ton of beets produced. The efficacy of 18 nonregistered insecticides is given in terms of percentage maggot damage reduction and yield. Some control effects on the following organisms were noted: beet leaf miner, bean aphid, nematodes, and curly top virus transmitted by the beet leafhopper. The relative effectiveness of insecticides currently cleared for sugarbeet root maggot control, in terms of yield, was from most to least: aldicarb, carbofuran, diazinon, fonofos, chlorpyrifos, terbufos, disulfoton, fensulfothion, and phorate.

KEYWORDS: Sugarbeets, sugarbeet root maggot, insecticidal control, economic threshold levels, *Beta vulgaris*, *Tetanops myopaeformis*, insecticide phytotoxicity.

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INSECTICIDE TESTS FOR CONTROL OF THE SUGARBEET ROOT MAGGOT, 1968-78

By C. C. Blickenstaff, R. E. Peckenpaugh, D. Traveller, and J. D. Stallings[1]

INTRODUCTION

The sugarbeet root maggot, *Tetanops myopaeformis* (Röder), is an important pest affecting sugarbeet production in Colorado, Idaho, Minnesota, Montana, North Dakota, Utah, Wyoming, and Canada. Losses to sugarbeets caused by insects were estimated at 12 percent of potential U.S. production (*28*).[2] We estimate losses due to the sugarbeet root maggot alone as 2 percent with losses in the infested area ranging from 0 to 100 percent. Preventive insecticide applications are currently the only means of control.

Published reports of field tests for control (using materials other than chlorinated hydrocarbons) are from Utah (*13*, *14*), Idaho (*25*, *26*, *27*), Wyoming (*8*, *9*, *10*, *11*), North Dakota (*12*, *15*, *16*, *17*, *18*, *24*), Alberta (*19*, *20*), and Manitoba (*1*, *2*, *3*, *4*, *5*). Most of these have been at-planting or postemergence soil treatments directed at maggots, but three reported sprays to kill adult flies (*12*, *18*, *26*).

This report presents results of tests conducted in southern Idaho from 1968 to 1978. These included adult control, at-planting and postemergence applications, timing applications in relation to adult activity, method of application, effect of sprinkler versus furrow irrigation, miscellaneous insecticides, and combinations of some of these. Tests prior to 1974 were conducted under the direction of W. E. Peay (deceased).

METHODS

In all tests where insecticides were applied to the soil surface, incorporated in the surface soil, or injected into the soil, application equipment was tractor mounted. Granular formulations were used with few exceptions. Rusken® applications at planting consisted of a shovel shoe in front of the planter,

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[2]Italic numbers in parentheses refer to Literature Cited, p. 26.

which scraped the top 1 inch of soil aside; a RoBander® distributor delivered the materials evenly in a 4- to 5-inch band onto the scraped surface, followed by sweeps that returned the soil covering the insecticide about 1 inch deep. The planter placed seed in the center of the band 3/4 to 1 inch deep. Postemergence applications with the RoBander deposited materials in a 4- to 5-inch band over the row. Drag chains were looped behind each RoBander to lightly disturb the soil surface for light incorporation. Chains worked well only when the soil surface was loose. Injection was done with Clampco® injectors either at planting or after emergence and at varying distances from the seed or plant row and at varying depths. The injectors were flattened, hollow tubes with the bottom openings to the rear.

A few tests were conducted to control adult flies at or near the peak of fly activity. These included sprays applied either by air or with tractor-mounted equipment, and insecticide-treated stakes.

Fly activity was sometimes monitored for timing of application and magnitude of population by use of sticky stake traps placed in the unplanted field margins (6).

The effectiveness of applications was measured in terms of percent plants infested, number of maggots per plant, or damage ratings. All evaluations were accomplished by digging plants in mid-July when most maggots were full grown. Percent plants infested was determined by the number showing feeding scars. The number of maggots per plant was determined by removing a core of soil surrounding a plant and passing it through a series of screens. This was replaced in later years by using a damage rating scale of 0 equals none to 5 equals severely damaged or dead (7).

Yields were determined during normal harvest by either hand digging, topping, and weighing; by lifting beets with a tractor-mounted lifter; by commercial beet harvester; or by experimental plot harvester (commercial harvester modified by addition of a weighing basket). The choice of method depended on location and size of plots.

Unless otherwise indicated, methods of analysis were analyses of variance and correlation. Significance is indicated by asterisks (** = significant at the 0.01 level of probability, * = significant at the 0.05 level, and ns = nonsignificant at the 0.05 level). Where significant differences occurred, values were separated by Duncan's multiple range test. Values followed by the same letters do not differ significantly. Capital letters denote significance at the 0.01 level and lower case letters denote significance at the 0.05 level of probability.

Overall results are discussed, bringing together data from individual tests. The details of individual tests are given in Appendix I where they appear by year and number within years (that is, 68-1, 2, 3, or 4). Chemicals tested are listed in Appendix II.

RESULTS AND DISCUSSION

Many factors affect the performance of insecticides used to control the sugarbeet root maggot and, ultimately, sugarbeet yield. Some of these are the

direct toxicity of the insecticide to the sugarbeet root maggot, the size or magnitude of pest populations, the presence of other damaging organisms (which may or may not be controlled, depending upon the action of the chemical, that is, broad spectrum versus narrow spectrum, systemic versus nonsystemic, nematocidal versus nonnematocidal, and so on), differences in phytotoxicity, the formulation used, the timing of application, the manner of application, mechanical damage to plants by the application itself, condition of the soil at time of application, and type of irrigation.

Other variables inherent in our tests and affecting results, but not discussed, are human and experimental errors, plant age and condition, and the ability of the sugarbeet plant to compensate for damage or loss in stand. Given these many variables, it is not surprising that results differ considerably among tests, locations, years, and workers; however, comparisons were made by averaging data from tests, involving several of the specific factors above.

ADULT FLY CONTROL

Several attempts to prevent sugarbeet root maggot damage by spray applications made during fly activity were reported from 1956 to 1969 (*12*, *18*, *19*, *26*). Materials tested and found ineffective were phorate (*12*, *18*) and trichlorfon (*19*). Peay et al. (*26*) reported significant reductions in number of maggots per beet following three applications of each of seven insecticides tested and significant yield increase for malathion and azinphosmethyl. They concluded that an application at peak fly emergence was most effective.

Spray tests reported here were applied either by airplane (68-3) or ground rig (68-4, 71-1, 72-1). Aerial application of malathion showed a dosage response, but differences among treatments were not significant. Three years of testing sprays with ground equipment yielded significant differences in only one field for number of maggots per beet in 1972. The best control was obtained with phorate, which averaged 65-percent (range, 40 to 83 percent) reduction of maggots following single applications, and 89-percent (range, 79 to 100) reduction with two applications 2 weeks apart. In comparison, trichlorfon averaged 30- and 48-percent maggot reduction. Diazinon, malathion, stirofos, and carbaryl gave little or no control. The data for phorate indicate that single applications, 14 days before peak fly activity, provided better control than those made at or near the peak.

Garden stakes treated with insecticides and set in fields to attract and kill flies were used in two tests (71-2, 72-2). Many flies were killed, but maggot damage was not reduced effectively. In both years, dichlorvos appeared to be more effective than propoxur in reducing the number of maggots per beet.

IRRIGATION

All sugarbeets grown in southern Idaho are under irrigation.

Data comparing sugarbeet root maggot populations or damage ratings under furrow and sprinkler irrigation were obtained in five tests: 74-1, 75-1, 75-4, 76-3, and 76-4.

A direct effect on flies and/or maggots due to type of irrigation was thought to be indicated in untreated check plots of two tests where methods varied in the same field. In the 74-1 test, the number of maggots per beet was 0.1 under sprinkler and 1.6 under furrow irrigation; however, in the 75-1 tests, the reverse occurred with damage ratings of 1.43 under sprinkler and 1.18 under furrow irrigation.

The effect of irrigation methods on the performance of insecticides in terms of reduction of damage from untreated checks is summarized in table 1. For aldicarb, reduction in damage ratings averaged five times greater under sprinkler than under furrow irrigation for nine comparisons. If the ratio value of 27.3 is omitted, the average is 2.2 times greater (range 0.9 to 3.8) for eight comparisons. There appears to be no clear-cut difference between method or time of application of aldicarb. For the other three materials, it appears that they were more effective under sprinkler irrigation when applied by RoBander, and more effective under furrow irrigation when applied by shanking. With the exception of test 75-1, these comparisons were made between tests duplicated in separate fields. The furrow irrigation fields in 1975 and 1976 had relatively heavy infestations, and times of planting, cultivation, and irrigation differed between the paired applications. Nevertheless, for aldicarb, the ratio between performance under sprinkler and furrow irrigation was similar to that obtained in the same field.

SPRAY VERSUS GRANULAR FORMULATIONS

Tests 70-2, 71-3, and 72-4 compared insecticides applied at planting using the same placement and at the same rates in granular and liquid formulations. There were no significant differences between the two formulations for any measurement for diazinon (three tests), fonofos (two tests), disulfoton (one test), and fensulfothion (one test). In all cases, materials were incorporated in the soil and were not in direct contact with the seed. For these materials applied this way, it appears that the choice of formulation is one of convenience and cost.

PLACEMENT OR METHOD OF APPLICATION

Numerous publications deal with methods of application, such as seed treatment, incorporation with fertilizers, in the seed furrow, banding over the row at planting with various widths and degree of incorporation in the soil, shank injection either at planting or postemergence, and banding over the row after emergence. These placements, methods, and times can have an effect on phytotoxicity, soil moisture, and mechanical plant damage as well as a direct effect on the sugarbeet root maggot.

Soaking seed in emulsions and coating them with slurries or dusts or applying insecticides with fertilizers in the seed furrow has generally proven too phytotoxic with most insecticides (*2*, *3*, *4*, *12*, *14*, *15*, *16*, *17*, *19*, *20*, *24*, *25*, *27*). Dorst (*13*, *14*), however, reported the effective use of phorate and

Table 1.--*Relative effectiveness of insecticides in reducing sugarbeet root maggot damage under furrow and sprinkler irrigation*

Method	Insecticide	Rate, in pounds of active ingredient per acre	Test	Percent reduction in damage ratings: Furrow	Percent reduction in damage ratings: Sprinkler	Sprinkler: furrow ratio
At planting						
Rusken	Aldicarb	2	75-1	89	100	[1]1.1
	--do--	1	75-4	23.9	84.1	3.5
	--do--	2	75-4	38.6	92.3	2.4
	--do--	1, 1.5, 2	76-4	2.5	68.2	27.3
Shanked below seed.	--do--	2	75-1	89	76.9	[1].9
Postemergence (7 or 8 days after peak fly)						
RoBander	--do--	2	75-1	33	96.5	[1]2.9
	--do--	1, 1.5, 2	76-4	22	83.1	3.8
	--do--	2	76-3	38.5	66.3	1.7
Shanked	--do--	2	76-3	53.8	73.8	1.4
RoBander	Phorate	2	76-3	26.1	37.1	1.4
	Fensulfothion	2	76-3	4.5	15	3.3
	Diazinon	2	76-3	2.2	4.5	2
Shanked	Phorate	2	76-3	17.8	.7	<.1
	Fensulfothion	2	76-3	10.8	7.1	.6
	Diazinon	2	76-3	-1	1.5	>1.5

[1]Same field; all other comparisons in 2 separate fields with widely differing fly populations.

disulfoton incorporated in the outer coating of pelleted seed without phytotoxicity, while providing good sugarbeet root maggot control and increased yield. Two reports (*2*, *11*) indicate that "in-seed-furrow" applications of the relatively less toxic carbofuran at reduced dosages may provide effective protection without phytotoxicity.

Currently recommended methods of application place insecticides close to, but not in contact with, seed at planting, and for postemergence applications, over the row with light incorporation or side injection (on the water furrow side in the case of furrow irrigation).

Comparisons of methods of application were made in four of our tests (75-1, 76-3, 77-4, 78-1).

The placement of aldicarb in relation to the seed row both at planting and after emergence under both furrow and sprinkler irrigation was evaluated in test 75-1. Under relatively light sugarbeet root maggot infestation, no significant differences in yield were obtained, but significant differences in damage ratings were obtained.

Under furrow irrigation, at-planting applications did not differ significantly whether applied by Rusken over the row or injected 3 inches deep at distances from the seed row of 0, 3, and 6 inches. The trend, however, was for better control closer to the seed and on the water furrow side. The same trend occurred under sprinkler irrigation. Postemergence applications by RoBander showed significantly better control under sprinkler than under furrow irrigation, but injections 6 inches on the side of the row did not differ significantly under either irrigation method. Thus, over-the-row applications were superior to injection except for postemergence applications under furrow irrigation.

In test 78-1, where sugarbeet root magot damage ratings were again low (1.06), mechanical treatments without chemicals did not differ significantly from each other or the untreated check, but the trend was for shanking to yield less tons per acre than over the row applications: shank after emergence, 18.2; shank at planting, 19.5; Rusken at planting, 20.4; and RoBander after emergence, 20.9 (check, 18.6). Shanking aldicarb after emergence, however, significantly decreased damage and increased yield. Aldicarb and thiofanox applied in the seed furrow at one-half rates (0.75 lb active ingredient (AI)/acre) gave fairly good damage control, but yield increases were not significant.

In tests 76-3 and 77-4, six insecticides were applied by shanking or over the row at varying time intervals and under both sprinkler and furrow irrigation. Since there was little or no consistent difference in relative performance under the two types of irrigation, they are combined and compared here in terms of percent reduction in damage ratings in table 2 and in terms of yield in table 3.

For damage ratings, there were 50 direct individual treatment comparisons between shank and Rusken or RoBander applications, 48 of which indicated some degree of control (table 2). Shanking materials provided slightly better maggot damage reduction on average, except when done at peak fly activity. The advantage of RoBander at peak fly could be due to direct mortality of adults coming in

Table 2.--*Comparison of over-the-row and shank applications in terms of percent reduction in damage ratings*

	Comparisons	Average reduction in damage		Percentage of times better	
		Over row	Shank	Over row	Shank
	Number	*Percent*			
Time of application (all chemicals combined)					
At planting	5	22.2	24.3	40	60
Peak fly	5	58.9	49.4	80	20
Peak fly + 7 days	12	19.9	22.6	50	50
Peak fly + 14 days	12	9	22.6	8	92
Peak fly + 21 days	8	6.2	11.4	38	50
Peak fly + 28 days	6	9.6	4.5	67	33
Chemicals (all times combined)					
Aldicarb	12	26.4	47.4	8	92
Terbufos	4	24.7	23.2	25	75
Carbofuran	4	23.6	23.4	50	50
Fensulfothion	8	5.4	6	50	50
Diazinon	9	11.1	6.4	56	33
Phorate	11	18.7	15.2	64	36
Overall					
	48	17.46	21.44	42	56

contact with insecticides on or near the soil surface during oviposition. The advantage of shanking was clear cut only for aldicarb. Over-the-row applications appeared to be best for diazinon and phorate.

There were 68 comparisons of percent yield increase or decrease in relation to untreated checks (table 3). Changes in yield were influenced by chemical, time of application, and infestation level in addition to method of application. The overall means in table 3 indicated for each chemical (except fensulfothion) and for most times of application a greater yield increase (or less reduction) occured for over-the-row applications than for shank applications. This is essentially the reverse of the results of damage ratings.

We conclude that although shanking tended to give better maggot control, it also mechanically disturbed plants more than over-the-row applications, generally resulting in less yield. This effect is even more evident when the data are

Table 3.--*Shanking versus over-the-row applications by chemical and time of application in terms of percent yield increase or decrease*

Insecticide	Method[1]	Total number of comparisons[2]	Change in yield: At planting	Peak fly	+7 days	+14 days	+21 days	+28 days	Average of peak, +7, +14	Average of all times	Individual comparisons: Shank better	No diff-erence	Over the row better
			Percent										
Aldicarb	S	16	-10.0	-0.6	4.2	5.4	0.7	0	2.99	-0.07	44	6	50
	R		- 5.2	3.2	3.1	.2	-2.3	2.0	2.17	.66			
Diazinon	S	12	- 1.3	-7.0	3.7	5.1	-5.1	.8	.61	- .62	25	8	67
	R		- 5.1	5.8	-2.6	5.0	-2.6	2.7	2.76	.55			
Carbofuran	S	8	- 5.2	-4.0	-1.3	.6			-1.20	-2.50	12		88
	R		- 7.2	1.6	3.8	4.3			3.25	.64			
Phorate	S	16	-10.0	-4.2	-4.1	2.9	-1.3	-1.4	-1.79	-3.00	31		69
	R		- 9.8	2.6	- .2	4.4	- .6	2.5	2.27	- .18			
Terbufos	S	8	- 5.2	-6.0	-7.4	0			-4.43	-4.64	25		75
	R		- 8.4	1.4	-2.2	2.1			.43	-1.79			
Fensulfothion	S	8			2.2	2.7	-5.5	.2		- .08	75	12	12
	R				-6.2	.4	-4.7	- .5		-2.75			
Totals or means:													
Aldicarb, diazinon, and phorate.	S	44	-7.12	-3.92	1.25	4.47	-1.91	- .17			34	5	61
	R		-6.70	3.90	.09	3.21	-1.84	2.42					
All chemicals	S	68	-6.36	-4.35	- .44	2.78	-2.81	- .08		-1.82	35.3	4.4	60.3
	R		-7.15	2.95	- .73	2.73	-2.55	1.70		- .48			

[1]S = shanking, R = over-the-row application.
[2]In individual comparisons, n = 2 except for aldicarb and phorate at 7 and 14 days when n = 4.
Note: Blank spaces indicate no data.

examined in relation to maggot population level as shown in figure 1 where mean data are plotted and regressions fitted by eye. At the very low population level of 0.2 damage rating, 24 of 28 applications decreased yield and shanking tended to decrease yields more than over-the-row applications. At higher damage levels, differences between shanking and over-the-row application were not clear cut, except at peak fly where over-the-row application was better.

PHYTOTOXICITY AND MECHANICAL DAMAGE

The importance of phytotoxicity to germinating sugarbeet seed and seedlings is well recognized. Materials currently labeled for use vary greatly in relative phytotoxicity. Direct seed treatments and insecticide-fertilizer mixtures applied in the seed furrow have proven to be too phytotoxic. The data indicate that materials applied at planting should be injected to the side of or below the seed or incorporated in a band in the upper 1 inch of soil. The relative phytotoxicity of the cleared materials (with the exception of terbufos for which no comparative data were found) and the importance of their manner of application are indicated by interpretation of stand loss data from four reports (*2*, *3*, *26*, *27*) summarized in table 4. Aldicarb and carbofuran are clearly much less phytotoxic than the other materials.

Additional reports of phytotoxicity tend to substantiate the data presented in table 4 for phorate (*4*, *16*, *17*, *21*, *22*, *24*, *25*), disulfoton (*19*, *24*), diazinon (*4*, *1*), fensulfothion (*1*), and fonofos (*1*).

Evidence of phytotoxicity, mechanical damage, or both is found in 10 of our tests as follows:

72-4. Under very light maggot populations, although reductions in stand and yield were not significant, the greatest reductions were from fonofos, disulfoton, and fensulfothion. Since applications were by Rusken at planting, the reductions were possibly due to phytotoxicity.

73-1. Terbufos G and fonofos S applied by Rusken at planting gave excellent maggot control under heavy pressure, but no significant increase in yield (fonofos), and only a slight increase for terbufos, which may indicate inhibited plant growth.

76-2. Fonofos applied by Rusken at planting provided the best maggot control but yielded less (but not significantly less) than carbofuran or aldicarb. The latter are systemic and may have controlled foliar insects or fonofos may have inhibited plant growth.

76-3. When average yields for the first two application dates after peak fly activity (8 and 15 days) are compared with those for the last two dates (21 and 28 days) for fensulfothion and diazinon, for which little or no maggot con-

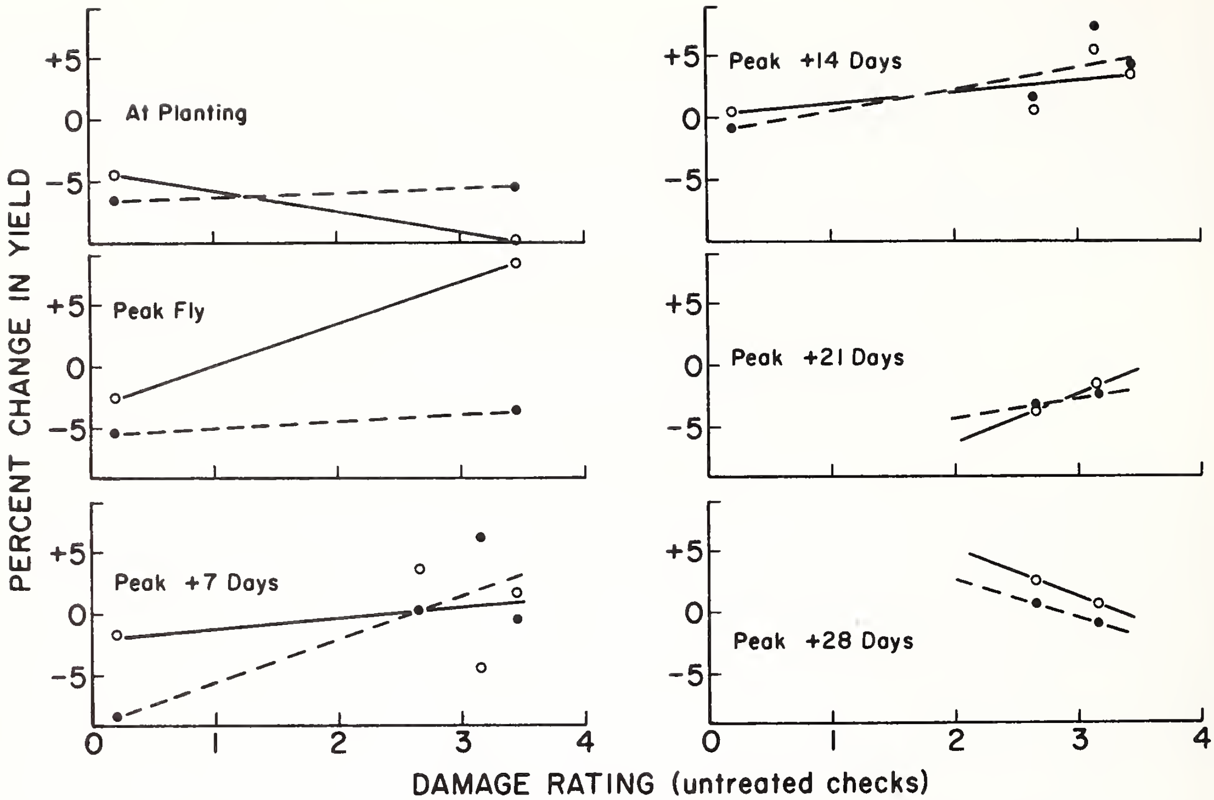

Figure 1.--The effect of shanking (●---●) versus RoBander (o——o) applications on yield when made at varying times in relation to varying maggot populations (as reflected by damage ratings in untreated check plots).

Table 4.--*Percent sugarbeet seedling stand loss as compared with untreated checks following treatment with insecticides derived from 4 published reports*

Insecticide	Method of application: To seed furrow[1]	To seed furrow with fertilizer[2]	Rusken[3]	Rusken[4]
Aldicarb		0 (1)	3.3 (3)	5 (3)
Carbofuran	10 (1)[5]	0, 0, 0 (1)	10 (2)	0 (2)
Disulfoton	28 (1)	16 (1.25)		15 (2)
Phorate	33 (1)	0 (1)	0 (1)	23 (2)
Fonofos	46 (1)	16 (1)	3.3 (2)	18 (2)
Fensulfothion	50 (1)		10 (2)	20 (2)
Diazinon	64+ (1)	28 (1.25)	3.3 (1)	13 (2)

[1]Granular materials slightly separated from and above seed (*2*, table 4).
[2]All granular materials mixed with fertilizer (*3*).
[3]Incorporated in 5- to 6-inch band over row in upper inch of soil (*27*).
[4]Incorporated in 5- to 6-inch band over row in upper inch of soil (*26*).
[5]Number in parentheses is pounds active ingredient per acre.
Note: Blank spaces indicate no data.

trol was obtained on any date, there is some evidence of decreased yield at the latter times shown as follows:

Date of application	Fensulfothion Furrow	Fensulfothion Sprinkler	Diazinon Furrow	Diazinon Sprinkler	Average
	Tons per acre				
8, 15 days	15.8	26.05	16.4	26.5	21.19
21, 28 days	15.45	25.35	15.55	26	20.59
Checks	15.6	25.7	16	26.2	20.88

Since the plants were becoming larger in time and presumably less subject to phytotoxicity, the slight decrease in yield was possibly due to mechanical application damage.

76-4. Since aldicarb is relatively nonphytotoxic and postemergence applications (RoBander plus drag chain) gave better maggot control but lower plant stands and yields than Rusken applications at planting, the difference is attributed to mechanical damage from the drag chain: reduction of 9.3 percent in stand and 6.38 percent in yield under furrow irrigation; and 23.2 percent in stand and 5.15 percent in yield under sprinkler irrigation.

77-1. Although differences were not significant, increasing dosages of chlorpyrifos gave increasing maggot control but decreasing yield, indicating phytotoxicity.

77-3. Although yields did not differ significantly, phorate applications at 2 lb AI/acre rate applied either at planting (Rusken) or after emergence (RoBander plus drag chain) tended to reduce yield as compared with 1-lb rates and the untreated check. Phytotoxicity is indicated.

77-4. Under furrow irrigation and dry, cloddy conditions, shanking applications at peak fly activity drastically reduced plant stand, but did not adversely affect plant stand with at-planting or after-peak fly applications. There was no evidence of phytotoxicity.

Under sprinkler irrigation, good soil conditions, and very few maggots, shanking consistently decreased both stand and yield as compared to over-the-row applications at each of four times of application. Both stand and yield were reduced more by earlier applications (at planting and peak fly activity) than later applications (6 and 16 days after peak fly). This is attributed to mechanical damage. Phorate, 2 lb AI/acre, shank injected reduced stand and yield more than other insecticides at the first three application times, and also tended to reduced yield when applied by Rusken and RoBander. This is attributed to phytotoxicity.

78-1. Although plant stand differences were not significant, the two postemergence shank injection treatments had the lowest stands. Shanking injection without chemical had the lowest stand and lowest yield. Other mechanical

treatments showed no reduction in stand or yield. Root maggot infestation was very low.

78-2. Under sprinkler irrigation, negligible root maggot infestation, and over-the-row applications, plant stands decreased significantly from at-planting applications to 14 days after peak fly activity. This may have been due either to increasing mechanical plant damage or progressively less control of unknown insects. All three insecticides, each averaged over the four dates of application yielded less, and two of them significantly less than the untreated checks. Thus, treatments in the absence of a damaging population were detrimental.

These data and observations implicate fonofos, disulfoton, fensulfothion, terbufos, chlorpyrifos, and phorate as causing phytotoxicity under some conditions. Mechanical damage is implicated in several tests with injection by shanking being more injurious than over-the-row applications.

TIME OF APPLICATION

In 1950, Jensen and Parrish (*23*) reported the successful use of ethylene dibromide as a postemergence sidedress application in late June for control of the sugarbeet root maggot. They showed a 2.8 tons/acre yield increase averaged over five fields due to maggot control, increased stand, and "a rather striking stimulating effect." Peay and Stanger (*25*) compared applications at planting to the drill row with postemergence applications in a 2-inch band over the row "when the adult flies emerged." At-planting applications of four insecticides gave two to two and a half times better maggot control in terms of percent control, but yield differences were not significant.

Allen et al. (*2*) showed band application of diazinon and fensulfothion made with 3 days of peak fly activity (up to 7 days after peak fly activity for fensulfothion) gave maggot control as good as in-furrow or above-furrow applications at planting, but similar late application of trichloronate and carbophenothion had little or no effect on maggots.

Frye et al. (*15*) compared yields following at-planting applications with applications made "after beet and fly emergence." Although differences were seldom significant, average yield for eight direct comparisons of six insecticides was 18.6 tons/acre for at-planting applications and 17.1 tons/acre for postemergence applications.

Burkhardt and Fornstrom (*9*) concluded that applications made one week after the first emergence of flies resulted in significantly better yield increase than at-planting applications even though maggot damage ratings were also higher. The comparison was summed over four insecticides and two methods of application. Burkhardt and Michels (*11*) presented data, again indicating the superiority of applications made one week after first fly as compared with at-planting applications, but it is not clear that the comparisons were made directly in the same test. Of 13 comparisons (six chemicals at varying rates), yields for 12 were greater for postemergence applications.

Most insecticides are applied at planting for control of the sugarbeet root maggot. As of this writing, only four (terbufos, aldicarb, chlorpyrifos, and diazinon) of the nine with label recommendations specifically for sugarbeet root maggot control give instructions for postemergence applications. The times specified for postemergence applications are "at the time of first fly emergence" or "up to the two- to four- leaf stage." All currently labeled applications, then, are of a preventive nature. Of our seven tests involving timing, four (73-1, 76-4, 77-2, and 77-3) compare at-planting with single postemergence treatments and three (76-3, 77-4, and 78-2) compare a series of application times in relation to peak fly activity. For the latter, the objective was to determine if one or more labeled materials could be applied after the potential for damage was known (as determined by sticky stake traps). The data for three systemic insecticides (aldicarb, phorate, and carbofuran) and two nonsystemic insecticides (terbufos and diazinon) are summarized in table 5.

The data indicate that at-planting applications made to very early plantings (61 to 70 days before peak fly activity for aldicarb, 41 to 50 days for the other insecticides) were less effective than at-planting applications made 21 to 30 days before peak fly activity. With the exception of aldicarb, it appears that at-planting applications made more than 40 days prior to peak fly activity were less effective in maggot control than either later at-planting applications or postemergence applications made up to time of peak fly activity. The efficacy of applications made after peak fly activity declined rapidly for all materials, the decline being most rapid for terbufos and diazinon, the two nonsystemics. This indicates that maggot control by systemic materials is at least partially due to feeding on roots containing the materials. The data strongly indicate that aldicarb is the only material tested under our conditions, that is, irrigation, that gives comparatively good control for up to 11 to 20 days after peak fly activity. It could, thus, be used for control after the fly population (and potential for damage) is known, rather than as a preventive. Under nonirrigated conditions, where moisture is uncertain, late application might not be as effective.

FLY AND MAGGOT POPULATIONS AND TIME OF INSECTICIDE APPLICATION IN RELATION TO YIELD

Our tests, prior to 1974, used maggot counts at midseason to determine percent control. Where yields were obtained, maggot counts in untreated check plots were correlated with percent change in yield for each insecticide. Since maggot infestations were found to be highly correlated with fly counts (6), later tests were monitored only with sticky stake traps.

Available data in our tests were examined for each registered insecticide applied at or near recommended rates to determine its relative efficacy in terms of yield when applied during four time intervals (at-planting, ±10 days of peak fly activity, 11 to 20 days after peak fly activity, and 21+ days after peak fly activity) and to determine the relationship between populations and yield change. The average effect on yield is summarized in table 6. The number of tests in which an insecticide was used for a particular time period varied from 1 to 29. For at-planting applications, mean populations of either maggots or flies did not vary greatly among chemicals, and yield changes are combined. Yield change varied from an average yield decrease of 0.54 percent for phorate to yield increases of 6.12 percent for carbofuran and 7.8 percent for aldicarb.

Table 5.--*Percent control of sugarbeet root maggot or damage in relation to time of application*

Days from peak fly activity	Aldicarb (1 and 2 lb)			Carbofuran (2 lb)			Phorate (1 and 2 lb)			Terbufos			Diazinon		
	No. tests	Range	x̄	No. tests	Range	x̄	No. tests	Range	x̄	No. tests	Range	x̄	No. tests	Range	x
		Percent			*Percent*			*Percent*			*Percent*			*Percent*	
- 61-70	2	21-46	33.5				2	25-42	33.5						
- 51-60	1		68												
- 41-50	7	40-92	65.8	5	22-81	46	3	14-38	24	4	4-95	49.5	2	13-18	15.5
- 21-30	3	2-100	60.3	2	64-85	74.5				2	90-98	94			
- 1-10	5	23-99	65.8	1		49	2	24-26	25				1		22
0 (peak fly)	3	44-88	64.7	3	26-50	36.7	3	41-67	52	2	52-86	69	2	25-47	36
+ 1-10	8	14-83	58.1	3	0-15	9	7	1-37	20.1	2	8-17	12.5	5	0-38	9.2
+ 11-20	9	12-87	48.2	5	0-34	17.6	7	0-38	12.6	2	1-15	8	5	0-13	7.4
+ 21-30	7	5-39	14.3				8	0-13	4.4				7	0-15	3
+ 33	1		43	1		35							1		1

Note: Blank spaces indicate no data.

Table 6.--*Average percent yield change (increase or decrease over untreated checks) following insecticide applications at planting and at 3 times in relation to peak sugarbeet root maggot fly activity*

Insecticide	At-planting applications					Postemergence applications: percent yield change for days ± peak fly activity		
	x̄ No. maggots per beet	x̄ percent yield change (Y_1)	x̄ No. flies per stake	x̄ percent yield change (Y_1)	Combined percent yield change	±10 (Y_2)	+11-20 (Y_3)	21+ (Y_4)
Aldicarb	2.2	[1]7.34(13)	152.5	8.17(16)	7.8 (29)	4.64(13)	2.86(8)	-0.34(5)
Carbofuran	2.44	7.14(11)	157.4	4.88(9)	6.12(20)	1.47(9)	3.95(6)	-2.5 (1)
Diazinon	1.91	4.66(15)	194.5	-1.3 (2)	3.96(17)	-2.6 (5)	1.08(4)	-2 (5)
Fonofos	1.96	4.37(14)	134.8	1.98(5)	3.55(19)	5 (1)	6.65(2)	-2.8 (1)
Chlorpyrifos	1.62	3.07(6)	70.6		3.07(6)	8.8 (1)	-.25(2)	5.1 (1)
Terbufos	2.98	4.2 (5)	174.3	.88(6)	2.38(11)	-.4 (4)	2.1 (2)	
Disulfoton	1.78	1.89(8)			1.89(8)			
Fensulfothion	1.83	1.2 (10)	68	.8 (1)	1.16(11)	-.5 (2)	3.15(2)	-1 (4)
Phorate	2.2	2.95(4)	152	-3.34(5)	-.54(9)	-3.09(10)	3.92(6)	-1.45(4)

[1] Numbers in parentheses indicate number of tests.
Note: Blank spaces indicate no data.

Yield changes were highly variable from test to test, and the data for postemergence applications are based on fewer tests and are, thus, less reliable. Except for aldicarb, postemergence applications made 11 to 20 days after peak fly activity resulted in the greatest average yield increases. We believe applications made ±10 days of peak fly activity tended to mechanically injure plants, and applications made more than 21 days after peak fly activity were simply too late to have an effect on maggots in addition to probable mechanical damage to plants. In the latter time interval, all insecticide treatments averaged reductions in yield.

The regression equations (yield change versus fly population) for each insecticide involved in four or more tests at a time interval are given in table 7. Only one correlation (carbofuran at planting versus maggots) was significant at the 5-percent level, but several others were very close to significance at that level (terbufos at planting versus maggots, fensulfothion at planting versus maggots, aldicarb ±10 days versus flies, aldicarb +10 to 20 days versus flies, and phorate +10 to 20 days versus flies).

In spite of the nonsignificance of most correlations, the regression equations are plotted in figure 2 for aldicarb, carbofuran, and phorate applications made at planting, ±10 days of peak fly activity, and 11 to 20 days after peak fly activity. These were the only materials involved in five or more tests in each time frame.

The regressions for at-planting applications (fig. 2A) indicate that aldicarb would be expected to increase yield about 3 percent even in the absence of flies, probably due to control of other insects and organisms, and with a total of 55 flies per sticky stake trap, aldicarb would increase yield 5 percent as compared with untreated checks. With a fly population of about 160 flies per stake, carbofuran treatment would increase yield 5 percent. Phorate at all but very high fly populations would decrease yields, probably due to its relatively high phytotoxicity. Decisions as to whether to make at-planting applications depend on expectations of damage based on past experience.

Postemergence applications (fig. 2B) made at or near peak fly activity can be made on the basis of fly populations as determined by sticky stake traps. In this case, the regressions show all three materials decreasing yield in the absence of flies. At peak fly activity, approximately one-half the total accumulated flies per season will have been trapped. Thus, for aldicarb applications at this time, 88 accumulated flies per stake (one-half of 176), would result in a 5-percent yield increase over untreated. For carbofuran, the number would be about 205 (one-half of 410), and for phorate the number would be about 200 (one-half of 400). These levels of fly counts are tentatively suggested as action levels justifying treatment applications. For yield potentials of 15, 20, and 25 tons/acre, treatments applied at these fly levels at or near peak fly activity should result in yield increases over untreated checks of 0.7, 1.0, and 1.25 tons/acre, respectively. Higher fly population levels would increase the yield differential more.

Applications made 11 to 20 days after peak fly activity (fig. 2C), when most flies will have been trapped, would require from 185 to 240 accumulated flies per stake to increase yield 5 percent.

Table 7.--*Regression equations of fly or maggot population on yield when insecticides were applied at planting or at selected times in relation to peak fly activity for registered materials involved in 4 or more tests*

Insecticide	No. of tests (n)	No. flies per stake or maggots per beet ($\bar{x}$)	Percent change in yield ($\bar{y}$)	S.D. X	S.D. Y	a	b	r
			At planting, X = maggots					
Aldicarb	13	2.2	7.34	1.13	8.38	-0.492	3.559	0.478
Carbofuran	11	2.44	7.14	1.2	5.87	-.62	3.172	.648*
Diazinon	15	1.91	4.66	.94	5.66	6.188	-.891	-.132
Fonofos	14	1.96	4.37	1	2.9	3.555	.416	.143
Terbufos	5	2.98	4.2	1.38	4.42	-4.024	2.76	.864
Chlorpyrifos	6	1.63	3.07	.63	6.55	1.271	1.101	.105
Disulfoton	8	1.78	1.89	.87	4.53	4.533	-1.491	-.287
Fensulfothion	10	1.83	1.2	.82	5.08	1.864	-.363	-.586
			At planting, X = flies					
Aldicarb	16	152.5	8.17	111.8	11.33	3.099	.033	.328
Carbofuran	9	157.4	4.88	124.9	9.3	.539	.028	.37
Fonofos	5	134.8	1.98	107.3	2.94	1.384	.004	.161
Terbufos	6	174.3	.88	101.4	8.34	4.54	-.021	-.255
Phorate	5	152	-3.34	154.7	10.13	-7.61	.028	.429
			±10 days of peak fly activity, X = flies					
Aldicarb	13	167.2	4.64	120.6	9.65	-2.121	.04	.506
Carbofuran	9	186.6	1.47	135	4.19	-1.557	.016	.522
Terbufos	4	194.5	-.4	119.5	5.39	-6.414	.031	.686
Diazinon	5	165.8	-2.6	95.2	4.32	1.394	-.024	-.531
Phorate	10	173.3	-3.09	133.7	11.02	-10.769	.044	.538

+11-20 days after peak fly activity, X = flies								
Carbofuran	6	182.8	3.95	139.8	4.78	.461	.019	.558
Phorate	6	165	3.92	131.9	9.35	-5.429	.057	.799
Aldicarb	8	168	2.86	126.4	6.75	-3.388	.037	.696
Diazinon	4	150.2	1.08	110.1	4.63	-.691	.012	.28
21+ days after peak fly activity, X = flies								
Aldicarb	5	120.8	-.34	66.8	6.28	3.552	-.032	-.342
Fensulfothion	4	123.5	-1	76.8	2.65	-1.65	.005	.152
Phorate	4	123.5	-1.45	76.8	1.42	-1.907	.004	.201
Diazinon	5	120.8	-2	66.8	3.11	-.272	-.014	-.307

*Significant at the 5-percent level.

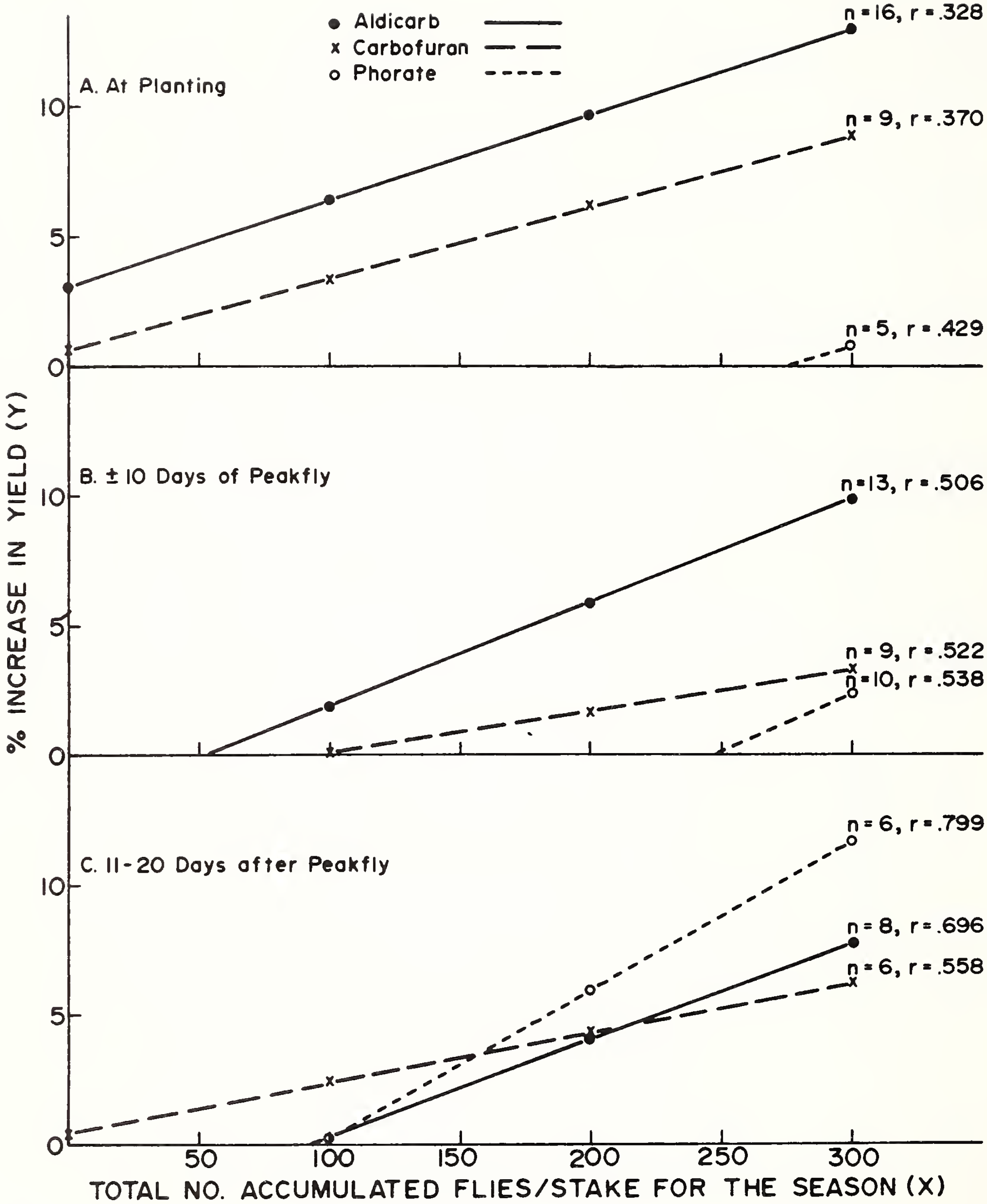

Figure 2.--Relation between sugarbeet root maggot fly populations and yield increase when treated with three insecticides at varying times (regression formulas in table 7).

Applications made 21 or more days after peak fly activity would be expected to be of little or no benefit (table 7).

Since the cost of treatment varies greatly with the insecticide used, a comparison of break-even points at 15, 20, and 25 tons/acre expected yields and expected grower returns of $20, $30, and $40/ton are given in table 8 as an example of how the above data might be used. These are the number of accumulated flies per sticky stake trap at or near peak fly activity (one-half the values indicated by regressions in fig. 2) that when treated would result in yield increases equal to the cost of application. Over the ranges given, the number of flies that would justify treatment with aldicarb varies from 63, for high yielding, high-priced beets, to 151, for low yielding, low-priced beets. For carbofuran, the numbers vary from 95 to 200 and for phorate, from 133 to 151.

MISCELLANEOUS INSECTICIDES

A number of materials not registered for control of the sugarbeet root maggot were tested. Nearly all were applied at planting by Rusken. The results are summarized in table 9. Insecticides are not strictly comparable since they were in one or more of seven tests in as many years (68-1, 69-1, 74-2, 75-3, 76-1, 77-1, 78-1); however, in terms of yield, isofenphos, CGA-12223, N-2596, acephate, and permethrin showed some promise. Some of these same materials also showed decreased yields at higher rates of application, which is probably evidence of phytotoxicity.

CONTROL OF OTHER INSECTS AND NEMATODES

Many of the material tested affect organisms other than insects as indicated in Appendix II. Some of these effects were noted in several of our tests.

Excellent control of the beet leaf miner, *Pegomya hyoscyami* (Panzer), was obtained by aldicarb in tests 74-1, 74-2, 77-2, and by terbufos in test 74-1 and 74-2.

Aphids, probably the bean aphid, *Aphis fabae* Scopoli, were controlled (95 percent) by aldicarb applied after emergence by shanking in test 78-1. In this test, sugarbeet root maggot damage was very low, 55 percent of the plants in untreated check plots were infested with aphids, and the significant increase in yield from aldicarb treated plots is attributed primarily to aphid control.

Curly top, transmitted by the beet leafhopper, *Circulifer tenellus* (Baker), appeared in test 77-2 as a mild infection. Percentage of plants with symptoms in aldicarb plots was reduced on July 22 by 68 to 73 percent for at-planting applications, and by 37 to 56 percent for postemergence applications.

Two tests (70-1 and 71-4) involved nematocides in fields with high populations of the sugarbeet cyst nematode, *Heterodera schachtii* Schmidt. Aldicarb, applied at the recommended rate of 4 lb AI/acre for nematode control, gave 91-to 100-percent control of the sugarbeet root maggot as would be expected. Carbofuran at 4 and 8 lb AI/acre also gave 91 to 100 percent control of root maggots.

Table 8.--*Accumulated sugarbeet root maggot counts per sticky stake trap at or near peak fly activity that would justify*[1] *treatment with 3 chemicals varying in cost and effectiveness at varying expected beet yields and price levels*

Expected yield (tons/acre)	Price per ton	Accumulated No. flies per stake to equal cost of application at or near peak fly activity[2]		
		Aldicarb 2 lb $30 approx.	Carbofuran 2 lb $15 approx.	Phorate 1.33 lb $7.50 approx.
	Dollars	*Number*		
15	20	151	200	151
	30	110	150	142
	40	88	126	138
20	20	120	162	145
	30	88	126	138
	40	72	105	135
25	20	101	140	140
	30	76	110	136
	40	63	95	133

[1]Equal the cost of application.
[2]Derived from regressions in figure 2.

Telone fumigant applied prior to planting appeared to significantly increase sugarbeet root maggot infestation and damage. The Telone probably destroyed other organism(s) in the soil that normally inhibit root maggot development or survival. Root maggot infestation and damage also tended to increase in oxamyl-treated plots.

ADDITIONAL OBSERVATIONS AND CORRELATIONS

Yun (*29*) discussed criteria for evaluating insecticides for control of the sugarbeet root maggot. He stated that, "frequently some treated plots which had various degrees of larval control actually showed lower root yields than untreated check plots," and this, "was more pronounced when infestations were light to moderate and the post-feeding weather conditions were favorable for recovery of injured beets." Yun, however, did not mention or discuss the possibility of insecticidal phytotoxicity or mechanical damage due to application. Our data abundantly demonstrate that these two factors are important in affecting yield, and phytotoxicity has been reported frequently. Yun briefly discussed stand loss and the remarkable ability of beets to compensate for it, which is well known. In our opinion, stand loss need not be severe to significantly affect yield. Maggot feeding damage without major stand loss can stunt plants and reduce yields. Of course, the two are related--the greater the feeding damage, the greater the stand loss.

Table 9.--*Efficacy of miscellaneous insecticides for control of sugarbeet root maggot applied at varying rates, 1968-77*

Insecticides	Percent control of maggots or damage at the following rates (lb AI/acre):							Percent yield increase or decrease at the following rates (lb AI/acre):						
	0.25	0.50	1.0	1.5	2.0	3.0	4.0	0.25	0.50	1.0	1.5	2.0	3.0	4.0
Applied at planting, Rusken														
Fenamiphos					56(4)		80(52)					<1(4)		7(48)
Isofenphos		[1]74(7)	86(7)		90(7)				12(3)	16(3)		10(3)		
Acephate		64(3)	82(3)		91(3)				21(3)	10(3)		4(3)		
N-2596		36(3)	95(3)		77(3)				10(3)	8(3)		5(3)		
CGA 12223	43(4)	43(4)	69(7)		100(3)		100(3)			5(3)		18(3)		-3(3)
Thiofanox			0(9)	0(9)	0(9)					6(9)	3(9)	8(9)		
SD 8832			73(4)		0(4)	0(4)				-14(4)		-23(4)	2(4)	
Trichloronate					71(27)							ns(27)		
ER-2441					88(40)							4(40)		
Oxamyl							17(8)							
UC 30045					53(40)							<1(40)		
Ethoprop							67(4)							
Cyanthoate					63(8)							0(8)		
Phoxim					65(11)							0(11)		
BTS-34-778 and GCP-6361.	4(4)	22(8)	22(8)		50(4)									
GCP-9646	11(4)	21(4)	8(4)											
Applied after emergence, RoBander														
Chlorpyrifos					61(48)							3(48)		
Permethrin[2]	61(4)							11(4)						

[1]Numbers in parentheses are the number of replicates the dosage was tested.
[2]Also tested at 1/16 and 1/8 lb AI/acre with lower control and about the same yield.
Note: Blank spaces indicate no data.

The differing actions of insecticides in controlling other organisms has seldom been taken into account or reported. Our data demonstrate the effectiveness of aldicarb in controlling the bean aphid, beet leafhopper, leaf miners, and nematodes, as well as the sugarbeet root maggot. This ability, plus its relative nonphytotoxicity, we believe, is responsible for its rather consistent superior performance in terms of yield. Some other insecticides as good or better than aldicarb in the direct control of the sugarbeet root maggot and some other insects, tend to adversely affect yield due to relatively high phytotoxicity. The effect of phytotoxicity may be expressed subtly by reduced vigor as well as by plant mortality. Thus, we conclude that the ultimate criterion for efficacy must be in terms of yield.

CORRELATIONS BETWEEN MEASUREMENTS

Blickenstaff et al. (7) reported highly significant correlations between number of maggots per beet and percent beets infested ($r = 0.9789$ and 0.9522), and between number of maggots per beet and numerical damage ratings on a scale of 0 to 5 ($r = 0.9736$) for some tests conducted between 1965 and 1971. On this basis, all tests reported here after 1973 used only the damage rating in assessing direct insecticidal effect on maggots.

Blickenstaff and Peckenpaugh (6) reported highly significant correlations between number of flies per stake and number of maggots per beet ($r = 0.91^{**}$). The same correlation (0.91^{**}) was reported for number of flies per stake and damage ratings for data obtained in 1975 ($n = 10$). Since then we have added 15 observations, and the total ($n = 25$) is graphed in figure 3. The relationship is still significant ($r = 0.752^{**}$). The lower r value is due primarily to two of the data sets for 1977 being far out of line. Except for these two, all damage ratings were less than 2.0 for 50 or fewer flies per stake, and all damage ratings were greater than 2.0 for 50 or more flies.

Correlations between some of the measurements made and reported here are summarized by test in table 10. The first column of correlation values essentially confirms the close relationship between infestation and number of maggots. Damage ratings versus plant stand would be expected to be negative especially under heavy infestations resulting in decreased stand, but our data show four negative and nonsignificant correlations and four positive correlations, three of which are significant. Good maggot control accompanied by phytotoxicity or mechanical application damage could account for the variations seen.

Of most concern are the correlations of various measurements with yield. Plant stand was positively correlated with yield in all 14 observations, 8 of which were significant, again indicating the rather close relationship. Percent plants infested and number of maggot per beet, in older tests through 1973, were all negativley associated with yield with 5 of 17 values being significant. The association between damage ratings and yield in later tests was not as consistent: of 15 values, 11 were negative and 5 of these were significantly so.

In test 77-2, infection by curly top was more closely correlated with yield ($r = -0.945^{**}$) than was maggot damage rating ($r = -0.852^{*}$). In test 78-1, bean aphid infestation and maggot damage ratings were equally related to yield ($r = -0.838^{**}$ and -0.832^{**}, respectively.). In this case, aphids and damage ratings were also significantly related ($r = 0.62^{*}$, not shown in table 10), and plants weakened by maggots were probably more attractive to aphids.

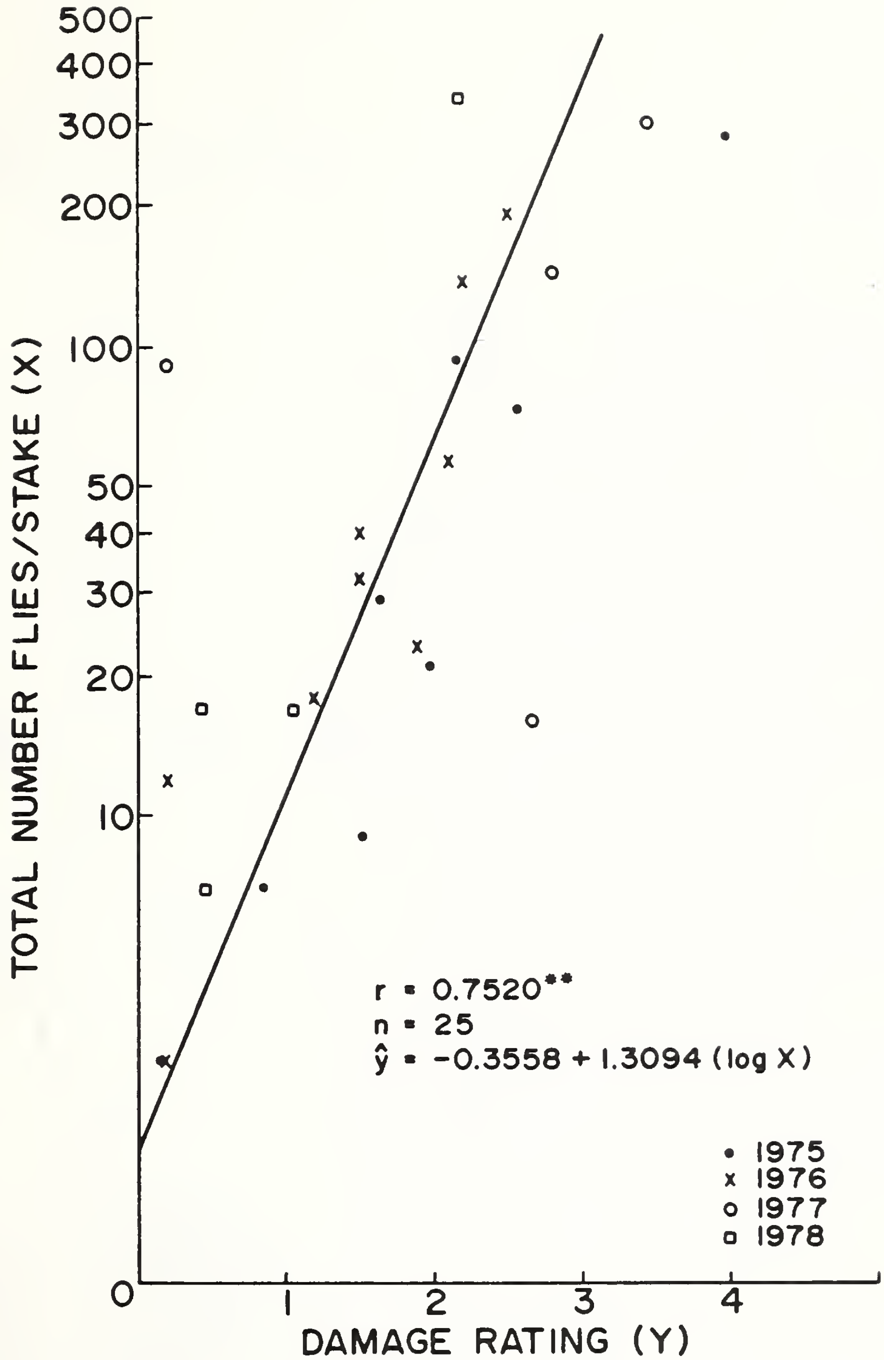

Figure 3.--Relationship between total number of sugarbeet root maggot flies trapped per sticky stake and damage ratings, 1975-78.

Table 10.--*Correlations between measurement treatment means in tests for control of the sugarbeet root maggot, 1968-78, Idaho*

Test No.	No. of treatment means	Percent infestation versus No. maggots	Damage rating versus stand	Yield versus-- Stand	Yield versus-- Percent infestation	Yield versus-- No. maggots	Yield versus-- Damage rating	Yield versus-- Miscellaneous correlations
68-1	12	0.966**			-0.564	-0.516		
68-2	5	.864			- .132	- .390		
69-1	5					- .978**		
70-1	6					- .681		
70-2	7					- .785*		
71-1	10	.862**						
71-2	4	.991*						
71-3	5	.924*			- .765	- .577		
71-4	9	.894**			- .668*	- .327		
72-1	10	.926**			- .726*	- .722*		
72-3	7	.961**			- .077	- .184		
72-4	12			0.828**				
73-1	144x4[1]	.559**		.571**	ns	ns		
75-3	16		-0.115	.461			-0.213	
76-2	7						.040	
76-3	8 furrow[2]						- .937**	
76-3	8 sprinkler[2]						- .769*	
76-4	12 furrow[2]		.659*	.806**			.443	
76-4	12 sprinkler[2]		.660*	.710**			.400	
77-1	7						- .594	
77-2	6[2]						- .852*	Curly top, -0.945**
77-3	10						ns	
77-4[3]	10 date 1		- .069	.458			- .001	
77-4[3]	10 date 2		- .331	.885**			- .428	
77-4[3]	10 date 3		.323	.714*			.001	
77-4[3]	10 date 4		- .579	.369			- .597	
77-4[4]	10 date 1			.397				

77-4[4]	10 date 2		.725*		
77-4[4]	10 date 3		.802**		
77-4[4]	10 date 4		.354		
78-1	13-17	.677*	ns	- .832**	Aphids, -0.838**
78-2	16			- .600*	

[1]Based on individual plots rather than treatment means.
[2]Aldicarb treatments only.
[3]Furrow irrigated.
[4]Sprinkler irrigated.
Note: Blank spaces indicate no data.

Other miscellaneous correlations not shown in table 10 were: 0.966** for number of scars per beet versus damage rating, 0.977** for number of maggots versus weight of maggots, and 0.809** for plant stand versus number of beets at harvest in test 73-1.

CONCLUSIONS

1. Attempts to control adults directly with insecticides have been largely unsuccessful.

2. Insecticide applications at or near peak fly activity were more effective in controlling maggots than applications at planting or 10 to 21 days after peak fly activity.

3. Maggots can be controlled effectively with aldicarb up to 10 to 15 days after peak fly activity. This allows time for assessment of potential damage and corrective rather than preventive treatment.

4. Percentage change in yield was correlated with fly populations, and fly populations can be assessed by use of sticky stake traps. Tentative economic threshold levels are established for varying insecticide effectiveness, cost of application, and expected yield and price.

5. In the absence of damaging populations, applications often decreased yield due to mechanical injury, phytotoxicity, or both.

6. Over-the-row applications, both at planting and after emergence, were generally less injurious to plant stand and more effective in increasing yield than injection applications.

7. The relative effectiveness of insecticides currently cleared for use, in terms of yield, was from most to least: aldicarb, carbofuran, diazinon, fonofos, terbufos, chlorpyrifos, disulfoton, fensulfothion, and phorate. These differences are partly due to relative phytotoxicity (aldicarb and carbofuran being least toxic) and partly due to the control of foliar insects by systemic action (aldicarb, carbofuran, and phorate) and control of nematodes (especially aldicarb).

8. Several nonregistered insecticides showed promise for control of the sugarbeet root maggot.

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APPENDIX I.--INDIVIDUAL TESTS BY YEAR AND NUMBER

1968-1 Miscellaneous Insecticide Test

Location: Vicinity of Burley.

Treatments: 11 insecticides all at 2 lb AI/acre at planting, 6-inch band over the row 1 inch deep.

Plot size: 4 rows x 50 ft.

Replication: 6 fields, 6 to 8 replicates per field, randomized within replicates.

Data: Percent infested, 10 plants per plot.

No. maggots per 10 beets per plot.

Yield, lb/100 ft of row (2 center rows of each plot).

The data are summarized in appendix tables 1, 2, and 3. Infestations in untreated checks ranged from 17 to 86 percent (Hackman and Grant fields). Maggot populations were light, ranging from 0.71 to 2.30 per beet. Significant differences among treatments were obtained in five fields for percent infested, in three fields for number of maggots, and in one field for yield. Significant differences tended to occur in those fields with the highest infestations and numbers of maggots.

Percent infestation and number of maggots per beet were closely correlated; fonofos and trichloronate means were nearly identical and ranked 1 and 2, the same for carbofuran and ER-2441, which ranked 3 and 4; however, these data did not correlate well with mean yield. For example, diazinon and aldicarb treatments resulted in the highest average yield, but were intermediate in terms of average infestation and maggots. Of the seven materials currently registered for control of the sugarbeet root maggot, four ranked highest in average yield, disulfoton and chlorpyrifos were intermediate, and fensulfothion was the same as the untreated check.

1968-2 Strip Tests, Registered Materials

Location: Vicinity of Burley.

Treatments: 5 registered materials all at 2 lb AI/acre at planting, 7-inch bands over the row and incorporated 3 inches deep with grower's equipment.

Plot size: 6 rows x length of field.

Replication: 2 fields, 5 and 6 replicates per field.

Data: Percent infested, 10 beets per plot.

Appendix table 1.--*Percentage of beets infested by sugarbeet root maggot. Miscellaneous insecticides, 1968*

Material (2 lb AI/acre)	Field[1] Grant	Icenbice	Grosch	Koch	Miller	Hackman	$\bar{x}$	Rank
Diazinon[2]	47 cde	48 abc	43 ab	19 ab	11 abc	12	30	9
Aldicarb[2]	46 bcde	30 ab	20 a	24 abc	24 bc	2	25	5
Fonofos[2]	6 a	5 a	23 a	13 a	1 a	10	10	1
Carbofuran[2]	17 abc	33 abc	26 a	20 ab	4 ab	3	17	3
ER-2441	33 abcd	25 ab	36 a	10 a	9 abc	2	20	4
Trichloronate	7 a	8 a	25 a	21 ab	4 ab	0	11	2
Chlorpyrifos[2]	43 bcd	32 abc	41 a	27 abc	16 abc	3	28	7
Disulfoton[2]	31 abcd	43 abc	31 a	36 abc	19 abc	5	28	8
Cyanthoate	76 ef	45 abc	44 ab	43 bc	21 abc	8	40	10
UC-30045	37 def	63 bc	53 ab	50 cd	28 c	2	42	11
Fensulfothion[2]	13 ab	33 abc	48 ab	33 abc	18 abc	8	26	6
Untreated	86 f	75 c	74 b	71 d	56 d	17	64	
F	10.48**	3.87**	3.87**	6.58**	9.10**	1.33 ns		
No. replicates	7	6	8	7	8	6		

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

[2]Currently registered for control of the sugarbeet root maggot.

Appendix table 2.--*Number of maggots per 10 beets in miscellaneous insecticide test, 1968*

Material (2 lb AI/acre)	Field[1] Grant	Icenbice	Grosch	Koch	Miller	Hackman	$\bar{x}$	Rank
Diazinon	5.3 abc	7.8 ab	4	0.4 a	2.5	5.5	4.1	6
Aldicarb	19.4 c	7.2 ab	.9	.4 a	6	.3	5.7	8
Fonofos	.1 a	.5 a	1.5	.4 a	.6	1.8	.8	2
Carbofuran	.1 a	3.3 a	2.6	.1 a	.5	1	1.3	3
ER-2441	3.4 abc	2.2 a	2.8	.6 a	1.4	.8	1.9	4
Trichloronate	.6 a	.3 a	1.4	.6 a	.6	0	.6	1
Chlorpyrifos	2.6 ab	5.5 ab	4.6	3.1 a	17.3	.3	6	9
Disulfoton	5.7 abc	10.3 abc	1.5	2 a	9.9	1.5	5.1	7
Cyanthoate	18.4 bc	9 ab	3.3	5 a	9.9	1	7.8	11
UC-30045	13.7 abc	15.8 bc	2.6	4.7 a	8.9	.2	7.5	10
Fensulfothion	.6 a	2.3 a	2.4	2.3 a	7.3	.3	2.7	5
Untreated	19.9 c	20.8 c	7.1	23 b	18.8	8.2	16.2	
F	4.02**	4.56**	1.66 ns	10.16**	1.78 ns	1.12 ns		

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Appendix table 3.--*Beet yield (lb/100-ft row) in miscellaneous insecticide test, 1968*

Material (2 lb AI/acre)	Field[1] Grant	Icenbice	Grosch	Koch	Miller	Hackman	$\bar{x}$
Diazinon	176	173	167	196 abc	186	226	186
Aldicarb	162	162	161	219 a	184	226	184
Fonofos	157	181	149	195 abc	195	228	183
Carbofuran	166	174	151	207 ab	194	211	183
ER-2441	166	169	160	197 abc	185	224	182
Trichloronate	159	170	145	204 ab	189	217	179

Chlorpyrifos	169	176	153	177 c	195	214	179
Disulfoton	152	159	160	187 bc	189	227	178
Cyanthoate	163	159	146	187 bc	191	225	177
UC-30045	149	142	160	188 bc	188	236	176
Fensulfothion	157	155	153	197 abc	173	223	175
Untreated	148	170	146	188 bc	185	222	175
F	1.69 ns	1.38 ns	1.07 ns	1.98*	0.55 ns	0.39 ns	

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

No. maggots per 10 beets per plot.

Yield, entire plot, T/acre.

The data are given in appendix table 4.

Infestation and number of maggots per beet were closely correlated, but these were not well correlated with yield. The diazinon treatment yield was good, but it showed poor maggot control. Carbofuran and phorate treatments resulted in both good maggot control and yield increase although there were no significant differences in yield.

Appendix table 4.--*Strip tests of registered insecticides in 2 fields, 1968*

Material (2 lb AI/acre)	Percent beets infested[1]		No. maggots per 10 beets		Yield (T/acre)	
	Field 1	Field 2	Field 1	Field 2	Field 1 (Dean)	Field 2 (Grosch)
Carbofuran	36 a		2.0 a		27.89	
Phorate	44 ab	45 ab	4.2 a	5.3	27.45	22.75
Diazinon	86 c	63 ab	20.6 ab	7.3	26.23	24.68
Disulfoton	76 bc	70 b	10.2 a	9.2	26.22	22.62
Fonofos	40 a	20 a	4.2 a	1.2	25.89	22.92
Untreated	84 c	73 b	32.8 b	11.2	25.13	22.35
F	7.81**	4.25**	6.97**	1.13 ns	ns	1.04 ns

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

1968-3, Aerial Applications for Fly Control

Location: Vicinity of Burley.

Treatments: Malathion 2, 4, and 8 oz AI/acre by air when flies were emerging.

Plot size: 10 acre average.

Replication: 7.

Data: No. maggots per 20 beets per plot.

Visual observation indicated good control of flies for only 1 day after application; however, the average number of maggots per beet in July was 0.89, 1.43, and 2.41 for 8-, 4-, and 2-oz treatments, respectively. The analysis of variance showed no significant differences among treatments.

1968-4 Ground Applications for Fly Control

Location: Vicinity of Rupert.

Treatments: 4 insecticides, single applications on 3 dates and a double application, ground equipment, 20 gpa.

Plot size: 3 to 5 acres, or several small fields.

Replication: In time only.

Data: No: of maggots per beet.

The data are summarized in appendix table 5. First fly emergence was on April 28, but cold, windy weather delayed activity and peak emergence was on May 28-29. Time of application obviously affected degree of control with treatments approximately 1 week prior to (May 22) and at peak fly activity (May 28), resulting in greatest reduction of maggots. Trichlorfon gave the best control of the materials tested.

Appendix table 5.--*Percent control of maggots by ground spray applications directed at flies,*[1] *1968*

Insecticide	Pounds active ingredient per acre	Percent reduction in maggots			
		Two applications	One application		
		May 17 and 24 (Hackman)	May 22 (Icenbice)	May 28 (Burgess)	May 17 (Hackman)
Trichlorfon	0.5	73.1	45.7	33	15.4
Diazinon	.5	0	28.7	26.2	3.8
Malathion	1.5	0	0	25.2	0
Stirofos	.5	0			
Untreated (No. of maggots per beet)		(1.04)	(3.41)	(5.15)	(1.04)

[1]Peak fly activity, May 28.
Note: Blank spaces indicate no data.

1969-1 Miscellaneous Insecticide Test

Location: Vicinity of Rupert.

Treatments: 4 insecticides, 2 rates each, applied at planting in 6-inch band over the row 1-inch deep.

Plot size: 4 rows x 50 ft.

Replications: 3 for 1-lb rates, 9 for 2-lb rates, repeated in each of the 3 fields.

Data: No. maggots per 10 beets per plot.

Yield in lb/100 ft of row per plot for 2 lb AI/acre rates in 2 fields.

The data were analyzed separately for each rate in each field and are summarized in appendix table 6. Significant differences among treatments were found only for number of maggots per beet at the 2-lb rates in the Hackman and Miller fields, and for the three fields combined. Although differences in yield were not significant, mean yield was well correlated with mean maggots in this test.

1970-1 Nematocide Strip Test

Location: Near Rupert.

Treatments: 5 nematocides at planting.

Plot size: 8 rows x length of field.

Replication: 4 for maggots, 3 for yield.

Data: No. maggots per 10 plants per plot.

Yield, whole plot, tons per plot.

The test was conducted in a field that had been continuously in beets for 20 years and was heavily infested with nematodes. It also had a relatively high population of sugarbeet root maggot. Materials were applied at high rates to determine effect on nematodes, but the effect on sugarbeet root maggot was also measured.

The results are given in appendix table 7. Although there were no significant differences among treatments for number of maggots per beet, three materials (aldicarb, carbofuran, and phenamiphos) gave 84 to 91 percent control. Yield differences were highly significant. Oxamyl and Tirpate, which did not control maggots effectively, increased yield slightly more than double the check. Aldicarb gave a threefold yield increase, which can be attributed to both nematode andd sugarbeet root maggot control.

1970-2 Strip Plots, Spray Versus Granular Formulations for Sugarbeet Root Maggot Control

Location: Near Rupert.

Treatments: 2 materials, 2 rates, sprays versus granular formulations, applied over the row at planting.

Appendix table 6.--*Number of maggots per beet and yield in miscellaneous insecticide tests, 1969*

	No. maggots per beet[1]								Yield (lb/100 ft row)		
	1 lb AI/acre (3 reps.)				2 lb AI/acre (9 reps.)				2 lb AI/acre		
Material	Hackman	Grosch	Miller	$\bar{x}$	Hackman	Grosch	Miller	$\bar{x}$	Grosch	Miller	$\bar{x}$
Trichloronate	0.57	0.83	0.1	0.5	0.61a	0.82	0.29a	0.57a	170	225	198
Fensulfothion	.23	.67	.53	.48	.16a	1.36	1.04ab	.85 b	176	210	193
Diazinon	.4	2.37	.73	1.17	.5 a	1.01	1.26 b	.92 b	172	210	191
Aldicarb	.27	.9	.83	.67	.66a	1.42	1.81 b	1.3 c	179	198	189
Untreated	.63	1.1	1.43	1.05	1.68 b	2.11	1.8 b	1.86 d	167	203	185
F	1.33ns	.9	1.41ns	ns	5.5**	1.79ns	8.06**	**	.54ns	1.93ns	ns

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Appendix table 7.--*Effect of nematocides on sugarbeet root maggot. Strip tests, 1970*

Material	Pounds active ingredient per acre	No. maggots per beet	Yield in tons per plot[1]
Aldicarb	4	0.7	2.4a
Carbofuran	8	.4	2 ab
Phenamiphos	4	.4	1.6 b
Oxamyl	4	2.9	1.9ab
Tirpate®	4	3.5	1.7 b
Untreated		4.4	.8 c
F		1.86ns	13.05**

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Plot size: 4 rows x field length.

Replicates: 4 in each of 2 fields.

Data: No. maggots per 10 beets per plot.

Yield, 100 ft strip per plot converted to tons/acre.

The data are summarized in appendix table 8. No significant differences were obtained by maggot counts in either field; however, sprays of fonofos in the Wakewood field reduced maggots more than comparable rates of diazinon. There were no apparent differences between spray and granular treatments of diazinon at either rate. Yield differences were significant in both fields, but treatment ranking was almost exactly the reverse. The reason for this is unknown, but an error in coding may have occurred. Data from the Wakewood field are assumed to be more reliable since the infestation there was greater and yields tend to be negatively correlated with maggots.

Appendix table 8.--*Effect of insecticide treatments on maggots and yield. Strip plot tests, 1970*

Material, rate (lb AI/acre), and formulation[1]		No. maggots per 10 beets			Yield in tons per acre[2]	
		Wakewood	Grant	Average	Wakewood	Grant
Fonofos	2 S	8	7	7.5	18.7a	17.5 cd
	1 S	20	7	13.5	17.3ab	19.1 bc
Diazinon	2 S	30	6	18	16.2abc	21.5ab
	1 S	40	6	23	16 abc	22.3a

Appendix table 8.--*Effect of insecticide treatments on maggots and yield. Strip plot tests, 1970--Continued*

Material, rate (lb AI/acre), and formulation[1]	No. maggots per 10 beets			Yield in tons per acre[2]	
	Wakewood	Grant	Average	Wakewood	Grant
Diazinon 2 G	32	3	17.5	16.3abc	24.6a
1 G	33	6	18.5	14.1 c	23.6a
Untreated	32	16	24	14.5 bc	15.9 d
F	1.21ns	2.2ns		2.67*	18.33**

[1]S = spray, G = granular formulation.
[2]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

1971-1 Sprays for Adult Flies, Ground Applications

Location: Near Rupert.

Treatments: 2 insecticides, 1 and 2 applications applied as sprays, all at 1 lb AI/acre with ground equipment in 14 gal water and 1 gal molasses/acre.

Plot size: 24 rows x field length.

Replication: 4 in field No. 1, 3 in field No. 2.

Data: No. maggots per 10 beets per plot.

Yield in 3 plots in field No. 2.

The data are summarized in appendix table 9. The first application a (single application) was made 4 to 5 days after first fly activity; the second application was made near peak fly activity. Although no significant differences were found among treatments for number of maggots, phorate indicated good control with both one and two applications and increased yield with two applications. Trichlorfon provided poor control and, apparently, decreased yield.

1971-2 Poisoned Stakes for Adult Fly Control

Location: Twin Falls.

Treatments: Garden stakes 1 x 12 inches painted black, soaked overnight in 5-percent solutions of dichlorvos or propoxur, and placed on 50-ft grids.

Plot size: 25 rows wide x length of field.

Replication: 2 in 1 field, 3 in another.

Appendix table 9.--*Effect on maggots and beet yield of ground spray applications directed at flies, 1971*

Material (1 lb AI/acre)	No.[1] appli-cations	Percent beets damaged			No. maggots per 10 beets			Yield, in tons/acre, in 3 plots of field No. 2
		Field 1	Field 2	$\bar{x}$	Field 1	Field 2	$\bar{x}$	
Phorate	2	3	15	9	0	2	1	25.2
	1	5	37	21	5	11	8	
Trichlorfon	2	17	60	38	26	22	24	
	1	35	53	44	22	37	30	21.1
Untreated		48	83	66	30	53	42	24.2
F					1.37ns	2.09ns		

[1]First application May 14-15; second, May 28-29. First fly caught on May 10, peak fly activity on May 28-June 7.

Note: Blank spaces indicate no data.

Data: Percent of beets damaged.

No. maggots per 10 beets per plot.

The stakes, placed in May during fly activity, "attracted and killed many flies, but did not significantly reduce the number of infested plants or the number of maggots/beet in late June." The test description is incomplete; apparently, there were no untreated check plots. However, the following data indicate dichlorvos-treated stakes to be slightly more effective than those treated with propoxur:

	Percent beets damaged		No. maggots per beet	
	Field 1	Field 2	Field 1	Field 2
Dichlorvos	15	80	0.4	3.7
Propoxur	25	90	1.2	4.9

1971-3 Granular Versus Liquid Applications in Strip Plots

Location: Near Minidoka.

Treatments: 3 insecticides at 1 lb AI/acre at planting, granules in 7-inch band and 2-1/2 inches deep, liquid delivered in 2 tubes per row 2-1/4 inches apart and 2 inches deep.

Plot size: 24 rows wide x length of field.

Replication: 2 fields, 4 replicates per field.

Data: Percent of beet infested.

No. maggots per 10 beets per plot.

Yield from whole plots converted to tons/acre.

The data are summarized in appendix table 10. Materials in descending order of effectiveness were fonofos, fensulfothion, and diazinon. Although there were no significant differences between granular and liquid applications, granular applications indicated slightly increased yields in each case.

Appendix table 10.--*Comparison of 3 materials applied in granular and liquid form to strip plots for control of the sugarbeet root maggot, Minidoka, Idaho, 1971*

Insecticide (1 lb AI/ acre)	Formulation[1]	Percent beets infested[2]		No. maggots per beet		Yield, in tons/acre	
		Field 1	Field 2	Field 1	Field 2	Field 1	Field 2
Fonofos	10 G	20a	48ab	0.3ab	3.2	26.4	21.5
	S	8a	33a	.1a	.9	25.9	21
Diazinon	14 G	38ab	78 b	.8ab	4.2	25.2	20.7
	S	33ab	78 b	1.3 b	3.7	23.8	20.2
Fensulfothion	S		53ab		1.9		20.2
Untreated		58 b	73 b	1.2 b	3.5	24.2	19.9
F		6.82**	5.38**	5.09**	2.02ns	2.17ns	.77ns

[1]G = granular, S = spray.

[2]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Note: Blank spaces indicate no data.

1971-4 Nematocide Strip Test

Location: Rupert.

Treatments: 5 nematocides applied in various ways and combinations to make 8 treatments plus an untreated check.

Plot size: 4 rows x field length.

Replications: 4.

Data: Percent scarred beets.

No. maggots per 10 beets per plot.

Yield, whole plot in tons/acre.

Sugar content.

The fumigant 1,3-D (Telone) was applied on April 6 by injection 12 to 15 inches deep. This was well before planting and the other applications on April 19. First fly activity was noted on May 11, peak activity was about May 28, and the last on June 30. Telone, then, would not be expected to have any effect on the sugarbeet root maggot. Two of the materials (aldicarb and carbofuran) were known to be effective against both nematodes and sugarbeet root maggot. The field was heavily infested with nematodes.

The results are presented in appendix table 11. Maggot data was transformed for analysis to $\sqrt{x + 1}$. For some unexplained reason, a significantly higher number of maggots and scarred beets was found in Telone plots. Oxamyl plots also tended to show an increase in maggot infestation and damage. All aldicarb treatments and carbofuran provided excellent control of the sugarbeet root maggot, but since these materials are also effective against nematodes, the relative effect of the two organisms on yield cannot be determined. Aldicarb alone (4 lb AI/acre) Rusken applied yielded significantly more than Telone alone at 20 gpa. There were no significant differences in sugar content due to treatment.

Appendix table 11.--*Effect of various nematocides on the sugarbeet root maggot and yield in a field heavily infested with nematodes, Rupert, Idaho, 1971*

Materials	Dosage[1] in AI/acre	No. maggots per beet[3]	Percent scarred beets	Yield, in tons/acre
Telone[2] + aldicarb	20 gal + 4	0 a	0a	29.7a
Aldicarb	4	0 a	3a	28 ab
Aldicarb (with seed)	2	0 a	0a	27.1abc
Aldicarb (side-dressed)	4	.02a	3a	26.2abc
Carbofuran	4	0 a	8a	23.5 bcd
Ethoprop	4	.3 a	13ab	20 de
Oxamyl	4	1.02a	40 cd	19.2 de
Telone[2]	20 gal	3.6 b	58 d	22.4 cd
Untreated		.62a	33 bc	15.5 e
F		8.26**	12.19**	13.99**

[1]Applied at planting on April 19. Except as indicated, applied in a band over the row by Rusken method.
[2]Applied on April 6.
[3]Values followed by the same letter do not differ significantly at the 1-percent level of probability, according to Duncan's multiple range test.

1972-1 Ground Spray Application for Fly Control

Location: Near Jerome.

Treatments: Phorate and carbaryl 1 lb AI/acre, 1 and 2 applications in 4- to 6-inch bands over the row in 20 gpa (containing 3 to 6 oz vinegar and 2 qt molasses).

Plot size: 36 rows wide x length of field.

Replication: 3 in field No. 1, 4 in field No. 2.

Data: No. maggots on 10 beets per plot.

Percent beets maggot damaged.

Yield, for whole plots in tons/acre.

The data are summarized in appendix table 12. Phorate was more effective than carbaryl in reducing maggot numbers and damage. Two applications of phorate were more effective than single applications before or at peak fly activity. Yield differences were not significant, and yields did not correlate well with number of maggots.

1972-2 Poisoned Stakes for Fly Control

Location: Near Jerome.

Treatments: Garden stakes 1 x 12 inches painted black and soaked overnight in 4.4-percent solution of dichlorvos or propoxur containing vinegar, molasses, and water; stakes replaced every 10 days during fly activity.

Plot size: Approximately 50 stakes on a 50- x 50-ft grid covering 2.5 acres.

Replication: Field split for insecticides; untreated in adjacent field.

Data: No. maggots per beet.

Many dead flies were observed, but the number of maggots per beet in July was 0.7 for dichlorvos, 1.6 for propoxur, and 0.5 for untreated. No effective maggot ccontrol was indicated and, therefore, yield data were not obtained.

1972-3 Comparison of Registered Materials, Strip Plots

Location: Near Minidoka.

Treatments: 5 cleared insecticides and 1 (fenamiphos) not cleared, all at 2 lb AI/acre in granular form at planting on April 11. Applied by grower over the row and incorporated.

No. maggots per 10 beets per plot.

Yield, whole plot in tons/acre.

Sugar content.

The fumigant 1,3-D (Telone) was applied on April 6 by injection 12 to 15 inches deep. This was well before planting and the other applications on April 19. First fly activity was noted on May 11, peak activity was about May 28, and the last on June 30. Telone, then, would not be expected to have any effect on the sugarbeet root maggot. Two of the materials (aldicarb and carbofuran) were known to be effective against both nematodes and sugarbeet root maggot. The field was heavily infested with nematodes.

The results are presented in appendix table 11. Maggot data was transformed for analysis to $\sqrt{x + 1}$. For some unexplained reason, a significantly higher number of maggots and scarred beets was found in Telone plots. Oxamyl plots also tended to show an increase in maggot infestation and damage. All aldicarb treatments and carbofuran provided excellent control of the sugarbeet root maggot, but since these materials are also effective against nematodes, the relative effect of the two organisms on yield cannot be determined. Aldicarb alone (4 lb AI/acre) Rusken applied yielded significantly more than Telone alone at 20 gpa. There were no significant differences in sugar content due to treatment.

Appendix table 11.--*Effect of various nematocides on the sugarbeet root maggot and yield in a field heavily infested with nematodes, Rupert, Idaho, 1971*

Materials	Dosage[1] in AI/acre	No. maggots per beet[3]	Percent scarred beets	Yield, in tons/acre
Telone[2] + aldicarb	20 gal + 4	0 a	0a	29.7a
Aldicarb	4	0 a	3a	28 ab
Aldicarb (with seed)	2	0 a	0a	27.1abc
Aldicarb (side-dressed)	4	.02a	3a	26.2abc
Carbofuran	4	0 a	8a	23.5 bcd
Ethoprop	4	.3 a	13ab	20 de
Oxamyl	4	1.02a	40 cd	19.2 de
Telone[2]	20 gal	3.6 b	58 d	22.4 cd
Untreated		.62a	33 bc	15.5 e
F		8.26**	12.19**	13.99**

[1]Applied at planting on April 19. Except as indicated, applied in a band over the row by Rusken method.

[2]Applied on April 6.

[3]Values followed by the same letter do not differ significantly at the 1-percent level of probability, according to Duncan's multiple range test.

1972-1 Ground Spray Application for Fly Control

Location: Near Jerome.

Treatments: Phorate and carbaryl 1 lb AI/acre, 1 and 2 applications in 4- to 6-inch bands over the row in 20 gpa (containing 3 to 6 oz vinegar and 2 qt molasses).

Plot size: 36 rows wide x length of field.

Replication: 3 in field No. 1, 4 in field No. 2.

Data: No. maggots on 10 beets per plot.

Percent beets maggot damaged.

Yield, for whole plots in tons/acre.

The data are summarized in appendix table 12. Phorate was more effective than carbaryl in reducing maggot numbers and damage. Two applications of phorate were more effective than single applications before or at peak fly activity. Yield differences were not significant, and yields did not correlate well with number of maggots.

1972-2 Poisoned Stakes for Fly Control

Location: Near Jerome.

Treatments: Garden stakes 1 x 12 inches painted black and soaked overnight in 4.4-percent solution of dichlorvos or propoxur containing vinegar, molasses, and water; stakes replaced every 10 days during fly activity.

Plot size: Approximately 50 stakes on a 50- x 50-ft grid covering 2.5 acres.

Replication: Field split for insecticides; untreated in adjacent field.

Data: No. maggots per beet.

Many dead flies were observed, but the number of maggots per beet in July was 0.7 for dichlorvos, 1.6 for propoxur, and 0.5 for untreated. No effective maggot ccontrol was indicated and, therefore, yield data were not obtained.

1972-3 Comparison of Registered Materials, Strip Plots

Location: Near Minidoka.

Treatments: 5 cleared insecticides and 1 (fenamiphos) not cleared, all at 2 lb AI/acre in granular form at planting on April 11. Applied by grower over the row and incorporated.

Appendix table 12.--*Reduction in maggot populations following spray applications to control flies, Jerome, Idaho, 1972*

Insecticide (1 lb AI/acre/ application)	Dates of May application[1]		Percent beets maggot damaged		No. maggots per beet[2]		Yield, in tons/acre	
	Field 1	Field 2	Field 1	Field 2	Field 1	Field 2	Field 1	Field 2
Phorate	9, 23	15, 30	33	14	0.7a	0.1	21.4	26.5
	9	15	45	23	1.4ab	.3	24.2	26.6
	16		50		1.3ab		20.2	
Carbaryl	9, 23	16, 30	58	29	2.8 bc	.4	20.9	28.1
		15		40		.6		25.4
Untreated			77	41	3.3 c	.5	21.1	25.1
F					4.11*	1.37ns	0.86ns	1.55ns

[1]Peak fly activity was on May 16.
[2]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.
Note: Blank spaces indicate no data.

Plot size: 6 rows x length of field.

Replications: 4.

Data: Percent of beets infested.

No. maggots per beet.

Yield, whole plot in tons/acre

Due to frost damage, the beets were replanted on May 1. The fly population was light with a total of 68 per sticky stake, and 1.1 maggots per beet in July. The data are summarized in appendix table 13. Aldicarb and terbufos gave the best maggot control, but none of the insecticide treatments differed significantly, and there were no significant differences in yield.

Appendix table 13.--*Maggot control and beet yield following applications of granular insecticides at planting, Minidoka, Idaho, 1972*

Materials (2 lb AI/acre)	Percent beets maggot damaged[1]	No. maggots per beet	Yield, in tons/acre
Aldicarb	18.7a	0.08a	26.5
Fonofos	18.7a	.23a	26.05
Fensulfothion	17.5a	.24a	26.05
Phenamiphos	31 ab	.48a	25.95
Diazinon	25 a	.23a	25.65
Terbufos	8.7a	.06a	25.55
Untreated	50 b	1.1 b	25.85
F	5.11**	6.43**	.8ns

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

1972-4 Comparison of Registered Materials, Small Plots

Location: Near Twin Falls.

Treatments: 7 registered insecticides, all at 2 lb AI/acre at planting on April 5; all applied in bands over the row with the Rusken incorporator; 4 were applied as both spray and granular formulations.

Plot size: 6 rows x 50 ft.

Replications: 5.

Data: Postthinning stand counts per 100 ft of row.

Yield, 200 ft of row converted to tons/acre.

Preliminary sampling in July indicated very low maggot counts and sampling was, therefore, not completed. The data are summarized in appendix table 14. There were no significant differences in yield. Phorate spray, diazinon granular, and aldicarb granular showed yield increases, and the remaining treatments indicated yield decreases. Yield differences may have been due to differences in stand since the two were significantly and highly correlated (r = .8277**).

Appendix table 14.--*Beet stand and yield following insecticide spray and granular applications to small plots subjected to negligible root maggot infestation, Twin Falls, Idaho, 1972*

Material (2 lb AI/acre)	Postthinning		Yield	
	Spray	Granular	Spray	Granular
	No. plants/100 ft		*Tons/acre*	
Diazinon	55	59	21	24.1
Aldicarb		53		23.6
Phorate	54		23.1	
Carbofuran		55		21.8
Fonofos	48	45	21.1	21.3
Disulfoton	44	47	20.5	20.5
Fensulfothion	43	38	20	18.5
Untreated	62		22.6	
F	ns		ns	

Note: Blank spaces indicate no data.

1973-1 Registered Insecticides, Pre- and Postemergence Applications

Location: Near Burley.

Treatments: 6 registered insecticides at 2 lb AI/acre, 1 nonregistered material (phenamiphos) at 4 lb AI/acre, and an untreated check. All except fonofos were applied in granular form. Three materials were compared as applied at planting and after emergence (at the first true leaf stage). All were applied in 5-inch bands over the row: Rusken at planting; RoBander plus drag chain after emergence.

Plot size: 6 rows x 45 ft.

Replication: 4 fields; 12 x 12 Latin square design in each.

Data: Plant stand before thinning, 10 ft of row, 2- to 4-leaf stage May 21 to June 15; plant stand after thinning, 90 ft of row, 6- to 8-leaf stage June 7 to 25; No. maggots on 5 beets, by sifting in July; yield, pounds, and No. of beets from 2 center rows (90 ft), machine harvested October 8-19; percent sugar and tare from 10 beets, field No. 3 only.

Pertinent fly and treatment data are as follows:

Treatment data	Field 1	2	3	4
Total No. flies per sticky stake	110	288	193	66
Peak fly activity	5/17	6/7	6/7	5/17
Days at planting treatment to peak fly activity.	21	42	48	29
Days from peak fly activity to postemergence treatments.	33	13	-1	19
Preemergence treatment	4/27	4/26	4/20	4/19
Postemergence treatment	6/19	6/20	6/6	6/5

The field data are summarized in appendix tables 15 and 16 with treatments arranged by average yield. Significant differences were found in all four fields for number of maggots per beet and in field No. 2 and combined fields for gross yield. Treatments tended to rank the same in all fields, and averages are, therefore, more meaningful than individual fields. On this basis, terbufos, aldicarb, and fonofos at planting provided the best maggot control. Aldicarb and terbufos at planting had the least reduction in stand. Aldicarb, both at-planting and postemergence applications, and carbofuran at planting resulted in the greatest yield increases. Pounds of sugar, based on percent sugar and tare for field No. 3, corresponded well with average tons/acre gross yield.

Correlations between measurement data were run for individual fields (n = 144) and, since they varied little among fields, the averages for significant values are given in appendix table 17. The highest correlation was between number and weight of maggots (0.977), thus, either would be a good measure of infestation. These were highly correlated with number of scarred beets, negatively correlated with midseason beet weight, but not with final harvest beet weight. The number and weight of beets at harvest were closely correlated (0.809), and these were about equally, but not closely correlated with post-thinning stand, percent stand loss pre- to postthinning stand, prethinning stand, and midseason beet weight.

These correlations may be somewhat misleading due to highly variable plot data. For example, the correlations between number of maggots and harvest yield on a plot basis for each field was nonsignificant, but the correlation is -0.615* using treatment means averaged over four fields (n = 12). Likewise, comparisons of correlations on the same basis for yield versus percent stand loss increases from -0.559** to -0.788**, and for present stand loss versus number of maggots increases from ns to 0.863**. The relatively low correlation values for yield versus maggots, and yield versus stand loss is due primarily to fonofos and terbufos at-planting treatments, which had good maggot control and low stand losses, but also relatively low yields. These two applications may have inhibited plant growth.

Appendix table 15.--*Stand loss and maggot infestation following applications of registered insecticides to 4 fields at planting and after emergence, 1973*

Material (2 lb AI/acre[1])	Time of application[2]	Percent stand loss, midseason to harvest for the following field Nos.: 1	2	3	4	$\bar{x}$	No. of maggots per beet for the following field Nos.:[3] 1	2	3	4	$\bar{x}$
Aldicarb	ap	7.2	7.1	11.5	9.7	8.9	0.46abc	0.24a	0.56ab	0 a	0.32
Carbofuran	ap	7.9	5.6	13	12.5	9.8	.34a	1.2 ab	.84ab	1.54ab	.98
Aldicarb	post	4.5	11.8	14	10.9	10.3	1.28abcd	1.06ab	.62ab	1.08ab	1.02
Phenamiphos	ap	8.2	6.9	17.8	7.7	10.2	.36ab	.68ab	1.28abc	.56a	.72
Terbufos	ap	7.6	3.2	18.8	6.5	9	.22a	.16a	.44a	.1 a	.22
Carbofuran	post	12.4	13.4	13.7	8.7	12	1.46abcd	1.98 bc	2.26abcd	4.22 cd	2.48
Fonofos (spray)	post	9.5	9.7	19.5	11.6	12.6	2.26 cd	.8 ab	3.54 d	5.26 d	2.98
Fonofos (encapsulated)	post	5.1	11.1	20.7	10.2	11.8	2.86 d	1.96 bc	2.82 bcd	5.18 d	3.2
Chlorpyrifos	post	6.9	17.3	15.4	11.5	12.8	.74abc	.68ab	1.3 abc	2.46 bc	1.36
Fonofos (spray)	ap	5.9	5.5	16.2	11.4	9.8	.52abc	.26a	.36a	.16a	.32
Diazinon	post	10.6	15.4	18.5	14	14.6	2.22 bcd	1.84 bc	3.46 cd	3.7 cd	2.82
Untreated		5.1	16.7	19	16.1	14.2	2.24 bcd	2.98 c	4.44 d	4.24 cd	3.48
F							4.28**	5.08**	6.5**	18.35**	

[1]Phenamiphos applied at 4 lb AI/acre; applied in granular formulation except as noted. Not registered for sugarbeet root maggot.

[2]ap = at planting; post = postemergence.

[3]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Appendix table 16.--*Beet yields following applications of registered insecticides to 4 fields at planting and after emergence, 1973*

Material (2 lb AI/acre[1])	Time of application[2]	Yield (lb/90 ft of row) for field No.-- 1	2	3	4	Average yield, in tons/acre[3]	Percent sugar	Percent tare	Pounds sugar per 360-ft row
Aldicarb	ap	190	197a	192	187	23.1a	15.5	11.5	105.29
Carbofuran	ap	186	187ab	179	189	22.4a	15.5	9.7	103.9
Aldicarb	post	195	174ab	185	184	22.3ab	15.6	10.7	102.67
Phenamiphos	ap	177	180ab	167	201	21.9 bc	15.4	13.1	97.08
Terbufos	ap	177	175ab	170	190	21.5 bcd	15.2	12.5	94.94
Carbofuran	post	173	165 b	172	191	21.2 cde	15.8	11.5	98.06
Fonofos (spray)	post	172	177ab	167	184	21.2 cde	15.2	11.3	94.58
Fonofos (encapsulated)	post	180	179ab	166	177	21.2 cde	15.7	10.2	99.07
Chlorpyrifos	post	186	164 b	173	174	21 cde	15.3	10.7	95
Fonofos (spray)	ap	175	170 b	158	186	20.8 def	15.7	12.4	94.04
Diazinon	post	172	161 b	161	171	20.1 f	15.7	11.4	92.47
Untreated		177	162 b	159	177	20.4 ef	15.4	10	93.69
F		0.62ns	1.68*	1.07ns	0.35ns	0.62*	ns	ns	

[1]Phenamiphos applied at 4 lb AI/acre; applied in granular formulations except as noted. Not registered for sugarbeet root maggot.

[2]ap = at planting, post = postemergence.

[3]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Appendix table 17.--*Correlation matrix, average of 4 fields*[1] *for data obtained from applications of registered insecticides, 1973*

Data		Data No.								
		7	6	2	9	1	3	8	4	5
Weight of harvested beets.	7		0.809	0.571	-0.559	0.378	0.248	ns	ns	ns
No. harvested beets	6	0.809		.809	- .523	.484	.19	ns	ns	ns
Stand after thinning	2	.571	.809		ns	.621	ns	ns	ns	ns
Percent stand loss after thinning to harvest.	9	-.559	-.523	ns		ns	ns	ns	ns	ns
Stand before thinning	1	.378	.484	.621	ns		ns	ns	ns	ns
Weight of beets, mid-season.	3	.248	.19	ns	ns	ns		-.298	-.262	ns
No. scarred beets	8	ns	ns	ns	ns	ns	-.298		.559	.541
No. maggots	4	ns	ns	ns	ns	ns	-.262	.559		.977
Weight of maggots	5	ns	ns	ns	ns	ns	ns	.541	.977	

[1]For individual fields, n = 144; for significance at P 0.05, r = 0.163; for significance at P 0.01 r = 0.213; ns = nonsignificant.

Yield increases were greater for at-planting compared with postemergence treatments of aldicarb and carbofuran, but the reverse was true for fonofos.

1974-1 and 2 Methods of Application and Irrigation

Location: Near Twin Falls.

Treatments: 2 insecticides at 1 and 2 lb AI/acre, applied by injection and by Rusken at planting, under furrow and sprinkler irrigation.

Plot size: 4 rows x 50 ft.

Replications: 4.

Data: No. beet leaf miner (BLM) mines per 100 plants.

No. maggots per 20 beets.

Soil compaction and crusting resulted in irregular emergence and variable stands rendering the test nearly worthless; however, general trends were indicated. Aldicarb provided excellent control of both BLM and sugarbeet root maggot. Fonofos provided good sugarbeet root maggot control but no control of BLM. Sprinkler irrigation possibly reduced infestations. The number of sugarbeet root maggots per plant was 0.1 under sprinkler and 1.6 under furrow irrigation; the number of BLM mines per 100 plants was 35 under sprinkler and 50 under furrow irrigation in untreated check plots.

A second test at the same location under furrow irrigation suffered from the same cultural problems; however, populations of BLM (No. mines per plant) and sugarbeet root maggot (No. maggots per plant) were terbufos 0.03 and 0.04, phorate 0.30 and 0.18, fensulfothion 0.20 and 0.26, SD 8832 0.54 and 0.45, and untreated check 0.60 and 0.55, respectively.

1975-1 Aldicarb Placement Under Sprinkler and Furrow Irrigation

Location: Kimberly.

Treatments: At planting (41 days before peak fly activity), 6 placements in relation to seed row; after emergence (7 days after peak fly activity), 3 placements in relation to plant row; all aldicarb at 2 lb AI/acre; all under furrow irrigation and repeated under sprinkler irrigation in the same field.

Plot size: 4 rows x 50 ft.

Replications: 4.

Data: Damage ratings on a scale of 0 to 5 in mid-July, 10 beets per plot.

Yield, from 2 center rows.

The data were analyzed as a single experiment. Yields did not differ significantly and no trends were indicated for placements, except that three of four over-the-row applications had lower yields than injected placements. Damage ratings are given in appendix table 18. Placements under furrow irrigation at planting did not differ significantly, but those closest to the seed row tended to have less damage, and placements on the water side tended to have less damage than those at equivalent distances on the other side of the row. Postemergence placements under furrow irrigation showed over-the-row did not differ significantly from the untreated check, but injections were better (not significantly) than corresponding placements at planting; again, placement on the water side was better than away from the water side. Under sprinkler irrigation, over-the-row applications resulted in least damage both at planting and postemergence. Again, the closer placement was to the seed, the better the control. In all four injection placements, 6 inches from the row, postemergence applications resulted in less damage than at planting applications.

In this test, there was no significant effect of irrigation method on damage in the untreated checks.

1975-2 Damage Ratings Versus Time of Planting

Location: Kimberly.

Treatments: Planting dates April 21, May 1, and May 12.

Plot size: 2 rows x 50 ft. Replications: 4.

Data: Damage ratings at midseason.

This test included five insecticides at three rates each applied at planting and after emergence, but the test was of little value due to uneven plant emergence and stand, soil variation, and low maggot population. Damage ratings on untreated checks, however, indicated either that the later planted beets had a larger maggot population or that being smaller they suffered relatively more damage. Damage ratings from early to late plantings were 0.375, 0.235, and 0.91.

1975-3 Miscellaneous Insecticides

Location: Kimberly.

Treatments: 5 insecticides at 2 or 3 rates each applied over-the-row (Rusken) at planting (May 12), plus aldicarb standard.

Plot size: 3 rows x 100 ft. Replications: 3.

Data: Plant stand, 20 ft of row.

Damage rating, 10 plants per plot.

Yield, 20 ft of row hand dug.

Appendix table 18.--*Sugarbeet root maggot damage ratings*[1] *as affected by aldicarb placement, time of application, and irrigation, Kimberly, 1975*

Placement of material	Furrow irrigation					Sprinkler irrigation				
	Distance (inches) from row:					Distance (inches) from row:				
	6	3	0	3	6	6	3	0	3	6
At planting										
Over-the-row (Rusken)			0.13a					0a		
Injected 3 inches deep	0.33ab	0.05a	.13a	0.25a	0.48abc	0.93 cd	0.4ab	0.33ab	0.5abc	0.77 bcd
After emergence										
Over-the-row (Robander + drag chain).			.78 bcd					.05a		
Injected 3 inches deep	.18a				.23a	.12a				.32ab
Untreated										
			1.18 de					1.43 e		

[1]All values horizontally and vertically accompanied by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Note: Blank spaces indicate no data.

Damage ratings were the only meaningful data and are summarized below. Because of the light sugarbeet root maggot infestation, damage rating data were converted to $\sqrt{x + .5}$ for analysis (F = 2.59*), but actual data are shown here. At the 0.05 probability level, means did not differ significantly between 0 and 0.17, and 0.13 and 0.73.

Insecticide	Damage rating for the following pounds of active ingredient per acre				
	0	0.5	1	2	4
Terbufos			0	0	
Isofenphos		0.13	.03	0	
CGA 12223			.03	0	0
N-2596		.47	.03	.17	
Acephate		.27	.13	.07	
Aldicarb				.03	
Untreated	0.73				

All compounds tested are indicated as being effective for sugarbeet root maggot control. Yield data were not significant and did not correlate well with damage ratings.

1975-4 Aldicarb Formulations, Sprinkler and Furrow Irrigation

Location: Near Minidoka.

Treatments: 4 granular formulations of aldicarb each at 1 and 2 lb AI/acre applied by Rusken at planting in each of 2 widely separated fields, 1 under sprinkler and 1 under furrow irrigation.

Plot size: 6 rows x 50 ft.

Replications: Five 5 x 5 Latin square design.

Data: Damage ratings on 10 beets.

Yield, 20 ft of row (10 ft of center 2 rows) hand dug.

Formulations did not differ significantly in either field for stand, damage, or yield. The data, averaged over the four formulations, are summarized below. Maggot control based on damage ratings was less under furrow than under sprinkler irrigation, but percent yield increases were greater because of the much higher infestation.

ate (lb AI/acre)	No. repli- cations	Damage		Yield		No. flies per sticky stake	Days from appli- cation to peak fly
		Rating	Percent control	Pounds per plot	Percent increase		
		Furrow (Heisel) May 2					
2	20	1.8	38.6	170.3	19.1		
1	20	2.23	23.9	162.6	13.7		
0	10	2.93		143		280	35
		Sprinkler (Miller) April 23					
2	20	.14	92.3	195	6.3		
1	20	.29	84.1	202.9	11		
0	10	1.82		182.7		74	44

1976-1 Miscellaneous Insecticides

Location: Kimberly.

Treatments: 6 insecticides at 3 rates each plus aldicarb and untreated check; application by Rusken at planting April 20.

Plot size: 3 rows x 50 ft.

Replications: 4.

Data: Damage ratings, 20 plants per plot.

Yield data were not obtained due to uneven stands. Damage ratings differed ignificantly as shown in appendix table 19. Chlorpyrifos, isofenphos, and CGA 2223 gave significantly better maggot control than aldicarb. GCP 6361 and BTS 4-778 are the same chemical in different formulations, and GCP 9646 is very losely related chemically; they performed essentially alike and gave little ontrol.

1976-2 Demonstration Fields With Strip Plots of 6 Registered Insecticides

Location: Minidoka, Burley, and Raft River.

Treatments: 6 registered insecticides each at 2 lb AI/acre applied by Rusken at planting.

Plot size: 6 rows wide x 600 to 800 ft long.

Replications: 3 (by field).

Data: Fly counts on 3 sticky stakes per field.

No. scars on 20 beets per plot in mid-July.

Damage rating on 20 beets per plot.

Yield from 50 ft of row (five 10-ft samples per plot) hand dug.

SEA personnel made the application, and data were taken by the Area Extension Specialist (Bob Stoltz), University of Idaho. The data are summarized in appendix table 20. All insecticides gave significantly better control of maggots than the untreated check, but there were no significant differences in yield; however, the highest yields were for carbofuran and aldicarb.

Appendix table 19.--*Miscellaneous insecticides tested for sugarbeet root maggot control, Kimberly, 1976*

		Damage rating for the following pounds of active ingredient per acre[2]			
Material	Formulation[1]	0.25	0.5	1.0	2.0
Chlorpyrifos	15		1.91 def	0.36a	0.35a
Isofenphos	15		.88abcd	.62abc	.52ab
CGA 12223	20	1.64 cdef	1.62 cdef	1.4 bcde	
GCP 6361[3]	10	2.69 fg	2.03 efg	1.98 efg	
BTS 34-778[3]	5		2.44 efg	2.42 efg	1.42 bcdef
GCP 9646[4]	10	2.52 fg	2.23 efg	2.51 fg	
Aldicarb	15				2.5 fg
Untreated					2.77 g

[1]Percent active ingredient per pound of granular material.
[2]Values followed by the same letters do not differ significantly either horizontally or vertically at the 1-percent level, according to Duncan's multiple range test.
[3]The same compound in different formulations.
[4]A compound closely related to GCP 6361.
Note: Blank spaces indicate no data.

Related data for 1976, by field, are as follows:

	Field location		
	Burley	Raft River	Minidoka
Irrigation	Furrow	Sprinkler	Furrow
Dates of peak fly activity	5/18-6/21	6/1-7	5/18-6/7
Date treated	4/14	4/29	5/3
Total No. flies per stake	203+	70	102
Midseason damage in untreated:			
No. scars per beet	20.1	12.1	11.0
Rating	3.0	2.4	2.7
Yield in tons per acre untreated.	27.92	28.27	31.12

Appendix table 20.--*Comparisons*[1] *of 6 insecticides recommended for sugarbeet root maggot control in 3 demonstration fields in southcentral Idaho, 1976*

Treatment (2 lb AI/ acre).	Formulation[2]	No. scars per beet	Damage rating	Yield in tons/acre	Yield, ranking 3 fields
Carbofuran	10	7.6 bc	1.95 c	32.43	1, 1, 2
Aldicarb	15	6.4 bc	1.98 c	31.48	4, 3, 1
Fonofos	10	1.8a	.86a	30.94	3, 4, 4
Phorate	15	2.6ab	1.14ab	29.77	7, 2, 4
Fensulfothion	15	4.5ab	1.46 b	29.6	2, 4, 6
Diazinon	14	4.5ab	1.45 b	28.82	6, 5, 3
Untreated		14.4 d	2.68 d	29.11	5, 6, 5

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

[2]Percent active ingredient per pound of granular material.

1976-3 Time of Application x 4 insecticides x Method of Application x Irrigation Type

Location: Area of Minidoka.

Treatments: 4 dates of application following peak fly activity; 4 registered insecticides (2 systemic and 2 nonsystemic) all at 2 lb AI/acre; 2 methods (shank injection versus RoBander + drag chain); and 1 field under furrow and 1 under sprinkler irrigation.

Plot size: 6 rows x 50 ft.

Replications: 6 in each field; each replicate was split in half, 1 half receiving shank injections 2 inches deep and 6 inches to the side of row (water row for furrow irrigation), and 1 half receiving over-the-row applications.

Data: Damage ratings on 20 beets per plot in mid-July.

Yield, from 2 center rows (100 ft) by mechanical harvester.

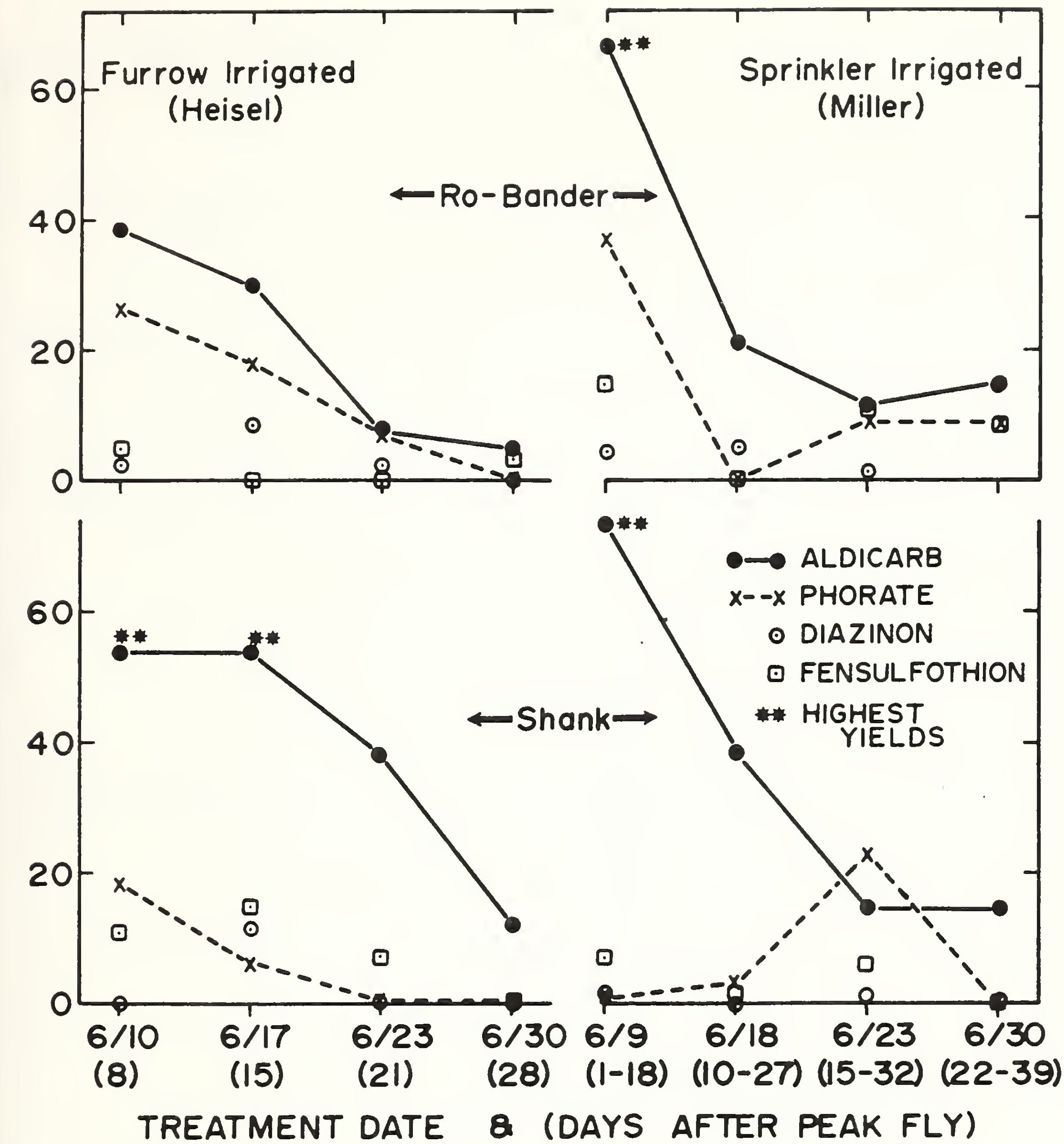
The major objective was to determine how late in relation to fly activity insecticides could be applied and still achieve effective control. The insecticides chosen and some of their characteristics are as follows:

	Systemic action	Nematocidal action	Water solubility (approx. p/m)	Recommended application rate (lb AI/acre)
Aldicarb	yes	very good	9000	1-2
Phorate	yes	weak	50	1.33
Fensulfothion	yes	good	1600	1-2
Diazinon	no	very weak	40	1-2

Field characteristics were as follows:

	Furrow	*Sprinkler*
No. flies per stake	190	57
Peak fly activity	June 2	May 22-June 8
Damage rating (checks)	3.14	2.67
Yield, tons/acre (checks)	16.0	26.3

The data are graphically presented in appendix figure 1. In terms of maggot control based on damage ratings, aldicarb almost always provided better protection than other materials, and its effectiveness declined with time after peak fly activity. In general, better control was achieved under sprinkler than under furrow irrigation, and shanking provided better control than banding over-the-row.



Appendix figure 1.--Sugarbeet root maggot control following late insecticide applications in 1976.

In terms of yield (appendix table 21), differences among treatments are less evident, but aldicarb at the earlier application dates provided the greatest yield increases, and yields declined rather uniformly with later application dates.

Of the four insecticides, aldicarb was the only one for which the correlaation between percent control of damage and yield change was significant; for the furrow-irrigated field r = 0.937**, for the sprinkler-irrigated field r = 0.769* (n = 8 for each field).

Split-plot analyses were performed by field for the interaction of factors. For maggot ratings, there were no significant interactions between methods of application and chemicals or methods and dates of application, but interactions were significant or highly significant between dates and chemicals. Dates (combining methods) for each chemical are, therefore, most meaningful and are presented in appendix table 21. Yield data are in the same table, but a significant increase occurred only for aldicarb under furrow irrigation. Maggot damage ratings tended to increase with dates of application. Shank applications were best for aldicarb, but the reverse was true for phorate. Method of application had no significant effect of yield.

1976-4 Aldicarb Substrates, Rates, and Time of Application

Location: Area of Minidoka.

Treatments: Aldicarb formulated on corn cob and gypsum granules at 1.0, 1.5, and 2 lb AI/acre, at planting (Rusken) and approximately 1 week after peak fly activity (RoBander + drag chain).

Plot size: 3 rows x 50 ft long.

Replications: 4, test repeated under sprinkler and furrow irrigation in separate fields as described in test 76-3.

Data: Stand on center row at midseason.

Damage ratings on 30 plants per plot.

Yield, by machine harvest on center row.

The data are summarized in appendix table 22. There was no significant difference between substrates or between dosage rates. The data are, therefore, averaged over 24 replicates in table 22; however, damage ratings did indicate a dosage response, and gypsum substrate was consistently better than corncob under sprinkler irrigation. Although postemergence applications provided better maggot control than at planting application, they also reduced stand yield in both fields. Stand and yield were highly correlated in both fields, r values being 0.806** in the furrow-irrigated field and 0.710** in the sprinkler-irrigated field (n = 12). Postemergence applications reduced yield by about 1.3 tons/acre, probably due to mechanical injury from the drag chain.

Appendix table 21.--*Maggot damage ratings and yield following application of 4 chemicals*[1] *by 2 methods at 4 times under furrow and sprinkler irrigation, Minidoka, 1976*[2]

Application: days after peak fly activity and methods	Furrow: Aldicarb	Furrow: Phorate	Furrow: Fensul-fothion	Furrow: Diazinon	Days after peak fly	Sprinkler: Aldicarb	Sprinkler: Phorate	Sprinkler: Fensul-fothion	Sprinkler: Diazinon
Maggot ratings									
Days:									
8	1.7A	2.4A	2.9	3.1a	1-18	0.8A	2.2a	2.4	2.6
15	1.8A	2.8AB	2.9	2.8a	10-27	1.9 B	2.6ab	2.7	2.7
21	2.4AB	3 BC	3.1	3.2ab	15-32	2.3 B	2.2a	2.4	2.6
28	2.9 B	3.2 C	3.2	3.3 b	22-39	2.3 B	2.7a	2.6	2.6
Method:									
Shank	1.9A	3 b	2.9	3.2		1.7	2.6	2.6	2.7 b
RoBander	2.5 B	2.7a	3.1	3.1		1.9	2.3	2.4	2.5a
Yield in tons/acre									
Days:									
8	17.4A	15.5	15.2	15.7	1-18	28.1	26.3	26.1	26.6
15	16.8A	17	16.4	17.2	10-27	26.4	27.1	26	26.4
21	15.7 B	15.8	15.1	15.3	15-32	25.9	25.5	24.7	25
28	15.6 B	15.8	15.8	15.8	22-39	27	26.4	26	27
Method:									
Shank	16.9	15.8	15.9	16.3		26.6	26.2	25.9	26
RoBander	15.9	16.2	15.3	15.8		27	26.5	25.5	26.5
Untreated check	16.4	16	15.6	16		26.8	26.4	25.7	26.2

[1]All at 2 lb AI/acre.

[2]Values in vertical groups followed by the same letter or no letter do not differ significantly; capital letters denote significance at the 1-percent level, and lower case letters at the 5-percent level, according to Duncan's multiple range test.

Appendix table 22.--*Effect of aldicarb applied[1] at planting versus postemergence on sugarbeet damage ratings, stand, and yield under 2 types of irrigation, 1976*

	Furrow			Sprinkler		
	At planting (May 3)	After emergence (June 10)	Check[2]	At planting (April 3)	After emergence (June 9)	Check[2]
Damage ratings	3.06	2.45	3.14	0.85	0.45	2.67
Stand (100 ft of row).	65.8	59.7		76.6	58.8	
Yield (tons/acre)	21.43	20.07	16.0	24.47	23.21	26.3
Peak fly activity	June 2			May 22-June 8		
Total No. flies per stake.	190			57		

[1]Averages of 24 replicates. 3 dosage rates (1.0, 1.5, and 2.0 lb AI/acre) and 2 formulations did not differ significantly and were, therefore, combined.
[2]Checks in adjacent test.

1977-1 Miscellaneous Insecticides

Location: Kimberly.

Treatments: Granular formulations of chlorpyrifos applied by Rusken at planting and permethrin applied by RoBander + drag chain at peak fly activity; both at 3 rates each.

Plot size: 6 rows x 50 ft.

Replications: 4.

Data: Damage ratings on 20 beets per plot.

Yield, on 2 rows (100 ft).

The data are summarized in appendix table 23. Fly activity peaked June 3 to 7, and only 16 flies per sticky stake were caught. This is very low in relation to the damage rating in untreated checks (2.79) and may be due to the field having been in beets the previous year so that emerging flies did not venture outside the field. Survey stakes were located on the unplanted margins of the test field. Chlorpyrifos applied at planting at 1.5 lb AI/acre provided excellent maggot control. Permethrin was much less effective. Although yields appeared to be increased by all treatments from 1.8 to 4.1 tons/acre there were no significant differences.

Appendix table 23.--*Miscellaneous insecticides tested for efficacy against the sugarbeet root maggot, Kimberly, 1977*

Material[1]	Pounds active ingredient per acre	Percent control[2] based on damage ratings	Yield in tons/acre
Chlorpyrifos	1.5	92.4 a	18.2
	1.0	83.4 ab	18.8
	.75	80.7 ab	20.4
Permethrin	.25	61.4 b	18.1
	.125	29.1 c	18.8
	.062	15.2 cd	18.4
Untreated			16.3

[1]Chlorpyrifos applied at planting (April 22), 43 days before peak fly activity; permethrin applied after emergence (June 2), 3 days before peak fly activity.

[2]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

1977-2 Aldicarb Rates and Time of Application

Location: Kimberly.

Treatments: Aldicarb at 1 and 2 lb AI/acre applied by injection 2 to 3 inches deep and 2 to 3 inches to the water side of the row at planting, April 15, and after emergence, June 2.

Plot size: 6 rows x 50 ft.

Replications: 6.

Data: Percent of plants with symptoms of curly top.

Percent of plants infested by leaf miner.

Damage ratings on 20 plants per plot.

Yield, from 100 ft of row per plot.

The data are summarized in appendix table 24. Curly top (CT) symptoms in untreated plots increased from 1.4 percent on June 20 to 11.3 percent on July 22. At planting applications were significantly more effective in reducing CT than postemergence applications. All applications provided nearly perfect control of beet leaf miner. Postemergence applications gave better control of sugarbeet root maggot than at planting applications. Although yield differences among treated plots did not differ significantly, early applications yielded more than late applications for both rates. This is undoubtedly due to the increased protection from CT.

Appendix table 24.--*Effect of aldicarb rates and times of application on curly top (CT) infection, beet leaf miner (BLM), sugarbeet root maggot (SBRM), and yield, Kimberly, 1977*

Pounds active ingredient per acre	Applied[1]	Percent reduction in CT symptoms[2]				Percent reduction of BLM June 20	Percent control SBRM	Yield, in tons/acre
		June 20	June 29	July 22	Average			
2	April 15	56	82	68	69a	98a	83a	25.7a
1	April 15	60	76	73	70a	96a	66 b	24.4ab
2	June 2	0	46	56	34 b	97a	99a	25.1ab
1	June 2	0	0	37	12 c	97a	97a	23.0abc
Untreated (actual values).		(1.4)	(2.8)	(11.3)	(5.2)c	(100) c	(2.6) c	20.7 c

[1]April 15 was 47 days before peak fly activity; June 2 was 7 days before; only 16 sugarbeet root maggot flies were trapped per stake.

[2]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

1977-3 Three Registered Insecticides, Times, and Rate of Application

Location: Nampa.

Treatments: At planting, March 21, applications by Rusken, and postemergence application by RoBander + drag chain on May 17. Rates at 1 and 2 lb AI/acre.

Plot size: 6 rows x 45 ft.

Replications: 5.

Data: Damage ratings on 20 beets per plot.

Yield, from 2 center rows by mechanical harvester.

The data are summarized in appendix table 25. None of the treatments differed significantly among themselves for damage ratings, but three at-planting treatments differed significantly from the untreated check for damage ratings. There was no correlation between damage ratings and yield. Although yields did not differ significantly, at-planting applications yielded more than postemergence applications in each case, probably due to plant damage. Phorate at 2-lb rates reduced yields as compared with 1-lb rates and the untreated check.

Appendix table 25.--*Comparison of 3 registered insecticides applied at planting and postemergence for effect on sugarbeet root maggot and yield, Nampa, 1977*

Insecticide	Pounds active ingredient per acre	Damage ratings[1]		Yield, in tons/acre	
		At planting	After emergence	At planting	After emergence
Aldicarb	1	2.24ab	2.17ab	36.6	34.4
Phorate	1	2.13ab	2.10ab	36.5	35.2
Aldicarb	2	1.53a	2.15ab	35.6	35.4
Phorate	2	1.64a	2.15ab	34.8	33.6
Fonofos	1	1.98a		35.1	
Untreated		2.83 b		35.5	

[1]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Note: Blank spaces indicate no data.

1977-4 Insecticide Time of Application and Placement

Location: Minidoka area.

Treatments: 4 times of application (at planting, near peak fly activity,

and 2 intervals after peak fly activity); 5 registered insecticides all at 2 lb AI/acre; 2 methods of application: shank injection 3 inches to the water furrow side and 3 inches deep, and banded over the row by Rusken at planting and RoBander + drag chain after emergence. Repeated on 2 fields, 1 furrow and 1 sprinkler irrigated.

Plot size: 6 rows x 45 ft.

Replications: 4 (furrow) and 6 (sprinkler).

Data: Damage ratings 10 beets per plot.

Yield, from 2 center rows (90 ft).

Beet count at harvest.

Peak fly activity occurred between June 3 and 10. Application times were:

Furrow			Sprinkler		
Date	Approx. days from peak fly activity	Plant height (inches)	Date	Approx. days from peak fly activity	Plant height (inches)
April 25	-41	0	April 18	-48	0
June 7	0	1	June 1	-6	2-3
June 13	6	2-4	June 13	6	6
June 21	14	4	June 23	16	9-12

The total number of flies per sticky stake trap was 298 for the furrow and 21 for the sprinkler-irrigated field.

The furrow-irrigated field was cloddy and dry, making applications difficult and incorporation poor at all three postemergence application dates. The sprinkler-irrigated field was in good condition for all applications.

Damage ratings averaged 3.43 in untreated plots of the furrow-irrigated field, but only 0.2 in the sprinkler-irrigated field. In the latter, therefore, damage ratings were not completed.

The results for damage ratings and yield are summarized in appendix tables 26, 27, and 28.

Furrow-Irrigated Field

Chemicals.--In the furrow-irrigated field where maggot populations were high, aldicarb was significantly better (in terms of damage ratings) than all but carbofuran at planting, with shank application outperforming Rusken application;

significantly better than carbofuran and diazinon at the second application; significantly better than the untreated check at the third application; and significantly better than all other treatments at the fourth application.

There were no significant differences among chemicals for each date of application for either beet count or yield; however, Rusken and RoBanders significantly reduced beet count on the first and fourth applications, and shanking severely reduced beet count on the second application.

Time of Application.--The best reduction in damage ratings was achieved at the second application by all insecticides. This time was significantly better than all other times for phorate and terbufos, but the second time also reduced beet count for all chemicals. Beet count was increased by RoBander and drastically decreased by shanking. Yield increases were best for the second and fourth application times, and lowest yields occurred for at-planting applications for each chemical.

Sprinkler Irrigated Field

In the sprinkler-irrigated field where maggots were insignificant, there were no significant differences among chemicals for beet count, but phorate decreased yield significantly at the first and third application times.

Earlier times of application tended to reduce both beet count and yield both for individual chemicals applied either over the row or by shanking.

Shanking reduced stand significantly at application time No. 3, and decreased yield significantly for aldicarb, carbofuran, and phorate averaged over the four times of application as compared with over-the-row applications. The rather consistent trend in this field was for the earlier the applications by both methods, the greater the decrease of both stand and yield; and the decreases were greater for shanking than for over-the-row applications.

Appendix table 26.--*Mean sugarbeet root maggot damage ratings following applications of insecticides at 2 lb AI/acre at 4 times and by 2 methods, Heisel field, furrow irrigated, 1977*

Treatment	At planting (April 25) 1st appl.	Peak fly[1] activity (June 7) 2d appl.	Peak fly activity plus 1 week (June 13) 3d appl.	Peak fly activity plus 2 weeks (June 21) 4th appl.	Averages 4 appl.	Averages 1st 2 appl.
Shank injection:						
Aldicarb	2.06	0.39	1.58	0.43	1.12	1.22
Phorate	2.94	1.79	2.24	2.75	2.43	2.36
Carbofuran	2.06	2.26	3.43	2.75	2.63	2.16

Appendix table 26.--*Mean sugarbeet root maggot damage ratings following applications of insecticides at 2 lb AI/acre at 4 times and by 2 methods, Heisel field, furrow irrigated, 1977--Continued*

Treatment	At planting (April 25) 1st appl.	Peak fly[1] activity (June 7) 2d appl.	Peak fly activity plus 1 week (June 13) 3d appl.	Peak fly activity plus 2 weeks (June 21) 4th appl.	Averages 4 appl.	Averages 1st 2 appl.
Terbufos	3.11	1.65	2.85	2.93	2.64	2.38
Diazinon	2.81	2.58				2.7
Check	3.41	3.41	3.3	3.51	3.41	3.41
Significance	*	**	*	**		
	Rusken	**RoBander**	**RoBander**	**RoBander**		
Aldicarb	1.66	1.91	2.93	3.02	2.38	1.78
Phorate	2.74	1.13	3.10	3.34	2.57	1.94
Carbofuran	2.66	1.71	3	3.1	2.62	2.18
Terbufos	3.3	.49	3.14	3.4	2.58	1.9
Diazinon	2.98	1.81				2.4
Check	3.44	3.44	3.44	3.45	3.45	3.44
Significance	ns	**	ns	ns		

[1]Peak fly activity was between June 3 and 10.
Note: Blank spaces indicate no data.

1978-1 Miscellaneous Insecticides

Location: Kimberly.

Treatments: 4 registered pesticides and 1 nonregistered insecticide were applied in granular form at planting on April 18 mostly by the Rusken method. Aldicarb and thiofanox were also applied in the seed furrow at reduced rates, and aldicarb was applied after emergence at peak fly activity by shanking on the water furrow side. Methods of application alone were also used as treatments to determine their effect on yield.

Plot size: 4 rows x 50 ft.

Replicates: 9.

Data: Plant stand per 100 ft of row, July 10.

Damage rating on 20 beets per plot, July 18 and 19.

Percent plant infested by black bean aphid in late August.

Yield on 100 ft of row by lifting and hand topping.

Appendix table 27.--*Mean stand and yield (4 replicates) following insecticide applications at 2 lb AI/acre on 4 dates*[1] *and by 2 methods for sugarbeet root maggot control, Heisel field, furrow irrigated, 1977*

Method and material	Stand per 90 ft of row					Yield per 90 ft of row				
	1st appl. (April 25)	2d appl. (June 7)	3d appl. (June 13)	4th appl. (June 21)	$\bar{x}$	1st appl. (April 25)	2d appl. (June 7)	3d appl. (June 13)	4th appl. (June 21)	$\bar{x}$
Shank injection:										
Aldicarb	94.8	68.5	89.5	95.8	87.15	127.5	145.3	151	157.5	147.58
Phorate	97	56.5	88	96.3	86.7	129.5	143.8	140	150	140.82
Carbofuran	98	63.3	92.5	87	85.2	137	136.8	148.5	145.8	142.02
Terbufos	97.3	63.8	80.8	97.5	84.85	135	135	132	145	136.75
Diazinon	94	64				148.3	131.5			
Check			85.5	86.3	85.9			144	135	139.5
$\bar{x}$ of 1st 4	96.8	65.3	87.7	94.2	86	132.2	140.2	142.9	149.6	141.22
Banded over row:										
Aldicarb	82	97.8	93	83.8	89.15	130.5	154.5	141	142	142
Phorate	81.3	99.8	94.3	84.8	90.05	126.5	156.5	151	147.8	145.45
Carbofuran	82.8	101.3	97	90.3	92.85	130.3	150.5	152	153.3	146.52
Terbufos	81.3	103	91.8	79.5	88.9	124.5	154.3	140.8	151.4	142.78
Diazinon	83.3	97.5				134.5	162			
Check			99.8	83.3	91.55			148.3	146.8	147.55
$\bar{x}$ of 1st 4	81.8	100.5	94	84.6	90.22	128	154	146.2	148.6	144.2
$\bar{x}$ of 8	89.3	82.9	90.8	89.4		130.1	147.1	144.6	149.1	

[1]Peak fly activity was between June 3 and 10.
Note: Blank spaces indicate no data.

Appendix table 28.--*Mean stand and yield (6 replicates) following insecticide applications at 2 lb AI/acre on 4 dates[1] and by 2 methods for sugarbeet root maggot control, Miller field, spinkler irrigated, 1977*

Method and material	Stand per 90 ft of row					Yield per 90 ft of row				
	1st appl. (April 18)	2d appl. (June 1)	3d appl. (June 13)	4th appl. (June 23)	$\bar{x}$	1st appl. (April 18)	2d appl. (June 1)	3d appl. (June 13)	4th appl. (June 23)	$\bar{x}$
Shank injection:										
Aldicarb	77.5	79	80.3	87.3	81	239.5	249	232	252.2	243.2
Phorate	80.2	76	75.8	89.3	80.3	229.3	233.7	226.8	253.3	235.8
Carbofuran	78.3	80.2	84.2	89	82.9	240.3	246.7	239.7	254	245.2
Terbufos	78.5	75.7	81.2	85.3	80.2	243.7	240	238.2	252.7	243.6
Diazinon	77.5	76				240.3	241.3			
Check			78.2	89	83.6			240.8	262.2	251.5
$\bar{x}$ of 1st 4	78.6	77.7	80.4	87.7	81.1	238.2	242.4	234.2	253	242
Banded over row:										
Aldicarb	83	80.5	85.7	89.5	84.7	251.5	252	254.3	256.3	253.5
Phorate	81.8	82.5	86.7	92	85.8	235.7	246	238.7	259.3	244.9
Carbofuran	81.2	86.5	88.3	88.2	86	242.2	251	260	260	253.3
Terbufos	85.2	79	83	89.3	84.1	246	243.7	248.7	251.8	247.6
Diazinon	81.7	80.5				245.5	252.3			
Check			88	88.8	88.4			256	262.8	259.4
$\bar{x}$ of 1st 4	82.8	82.1	85.9	89.8	85.2	243.8	248.2	250.4	256.8	249.8
$\bar{x}$ of 8	80.7	79.9	83.2	88.8		241	245.3	242.3	254.9	

[1]Maggot damage was negligible; 91 flies per stake, peak fly activity June 7.
Note: Blank spaces indicate no data.

The total number of flies per sticky stake was 17 (very low) with peak flight activity about June 9. The data are summarized in appendix table 29. There were no significant differences in stand, although the two postemergence, shanking (side-dress injection (SDI)) treatments had the lowest stands. The only treatment significantly better than others for damage rating and yield was aldicarb applied after emergence at peak fly activity by SDI. This treatment obviously also gave good control of bean aphid although the difference was not significant. Although there were few significant differences among treatments for damage rating and aphid infestation, both were significantly and negatively correlated with yield with r values of 0.832** (n = 13) and 0.838** (n = 17) respectively. Application methods alone in this test had no significant effect on stand or yield except as noted above for postemergence SDI.

Appendix table 29.--Miscellaneous insecticide test for control of the sugarbeet root maggot, Kimberly, 1978

Material	Method[1]	Pounds active ingredient per acre	Stand per 100-ft row	Damage rating 0 to 5	Percent bean aphid plants infested	Yield, in tons/acre
Aldicarb	SDI pe	1.5	63.6	[2]0.26a	2.7	25 a
	ISF	.75	69.4	.75 b	35.3	20.4 b
	R-K	1.5	69.4	1.02 bc	44.7	19.2 b
	SDI	1.5	72.9	1.09 bc	38.2	19.4 b
Thiofanox	ISF	.75	69.9	.97 bc	41.2	19.6 b
	R-K	1	73.2	1.11 bc	34.2	19.7 b
	R-K	1.5	74.3	1.37 c	27.3	19.2 b
	R-K	2	69.2	1.24 bc	40.5	20 b
Phorate	R-K	1.33	70	1.04 bc	39.6	18.3 b
Carbofuran	R-K	2	69	1.12 bc	44.4	19.6 b
Fonofos	R-K	1.5	69.3	1.18 bc	45.8	18.9 b
None	R-K		77.7		26.4	20.4 b
	SDI		68.6		47.5	19.5 b
	SDI pe		58.2		47.1	18.2 b
	Drag chain pe		67.2		41.2	20.9 b
Untreated			65.1	1.06 bc	54.8	18.6 b

[1]SDI = side-dress injection, ISF = in seed furrow, R-K = Rusken, pe = postemergence at peak fly activity June 9.

[2]Values followed by the same letter do not differ significantly at the 5-percent level, according to Duncan's multiple range test.

Note: Blank spaces indicate no data.

1978-2 Time of Application of 3 Registered Insecticides

Location: Minidoka area.

Treatments: 3 registered systemic insecticides applied at recommended rates at 4 time intervals to 2 fields (1 furrow and 1 sprinkler irrigated), all banded over the row (Rusken at planting, RoBander + drag chain after emergence).

Plot size: 6 rows x 50 ft.

Replicates: 6.

Data: Damage ratings on 20 beets per plot.

Yield, from 2 center rows (100 ft) by machine harvest.

Beet count at harvest.

Total number of flies per sticky stake was 337 at the furrow-irrigated field and only 17 at the sprinkler-irrigated field. Peak fly activity was on June 9. Applications at planting were by Rusken and by RoBander + drag chain at peak fly activity (June 8), 1 week later (June 15), and 1 week later (June 22).

The data are summarized in appendix table 30. In the furrow-irrigated field with a relatively high fly population, there were significant differences in damage rating among materials for each date of application with aldicarb performing best on each date and being significantly better than phorate and carbofuran combined over dates. The second application (at peak fly activity) significantly reduced damage as compared with the other three application dates. These differences did not relate well to yield except when yields were combined over dates of application when aldicarb yielded significantly better than the untreated check. There were no significant differences in beet count for treatments alone or in combination.

In the sprinkler-irrigated field, damage ratings were discontinued when untreated checks were found to have essentially no damage. Here, all insecticide treatments reduced yield over the untreated check when combined over dates of application, and beet counts were reduced significantly as application dates progressed from first to last.

Appendix table 30.--*Damage ratings and yield following applications over the row of 3 systemic insecticides*[1] *at 4 times under sprinkler and furrow irrigation, Minidoka area, 1978*

Insecticide	Furrow application					Sprinkler application				
	1st (April 24) -44 days	2d (June 8) peak fly	3d (June 15) +7 days	4th (June 22) +14 days	$\bar{x}$	1st (April 12) -56 days	2d (June 8) peak fly	3d (June 15) +7 days	4th (June 22) +14 days	$\bar{x}$
					Damage ratings					
Aldicarb	[2]1.35a	0.75a	0.82a	1.08a	1.0 A					
Phorate	1.44a	1.17ab	1.76 b	1.42ab	1.45 B					
Carbofuran	1.7 a	1.46 b	1.72 b	1.75 b	1.66 B					
Untreated	2.33 b	1.98 c	2.02 b	2.31 c	2.16 C					
$\bar{x}$	1.71 b	1.34a	1.58 b	1.64 b						0.42
					Yield, in tons/acre					
Aldicarb	25	27	27.6	27.4ab	26.7a	34.2	30.8	30.7	31.3	31.3 b
Phorate	27.7	24.6	24.7	28.1a	26.3ab	30.9	32.5	21.4	30	31.2 b
Carbofuran	28.5	25.6	24.3	25.6 bc	26 ab	32.7	30.7	31.6	31.9	31.7ab
Untreated	24.4	24.9	24.7	23.5 c	24.4 b	34	32	31.4	33.1	32.6a
$\bar{x}$	26.4	25.5	25.3	26.1		32.5	31.5	31.3	31.6	
					Beet count at harvest					
$\bar{x}$ of 4 treatments.	96.5	93.6	93.6	93.8		100.9a	97.8ab	97.1ab	93.4 b	

[1]Rates AI/acre: aldicarb and carbofuran 2 lb, phorate 1.33 lb.

[2]Values followed by the same letter or no letter (vertically for insecticides within treatment dates, horizontally among $\bar{x}$ treatment dates) do not differ significantly at the 1-percent level; lower case letters, at the 5-percent level, according to Duncan's multiple range test.

Note: Blank spaces indicate no data.

APPENDIX II

Table 1.--*Common names, trade names, and chemical names of materials mentioned in text and tables*

Common name	Trade name(s)	Use class[1]
Acephate	Orthene	I
Aldicarb[2,3]	Temik	I, N, Ac
Azinphosmethyl	Guthion	I, Ac
Carbaryl	Sevin	I
Carbofuran[2]	Furadan	I, N
Carbophenothion	Trithion	Ac, I, N
Chlorpyrifos[2]	Lorsban, Dursban	I
Cyanthoate	Tartan	Ac, I
1, 3-D[3]	Telone	N, F, fumigant
Diazinon[2]	Diazinon	I, N, Ac
Dichlorvos	Vapona, DDVP	I, fumigant
Dimethoate	Cygon	I, Ac, N
Disulfoton[2]	Di-Syston	I, Ac, N
Ethion	Nialate	Ac, I
Ethoprop	Mocap	N, I
Ethylene dibromide	EDB, Dowfume W-85	I, N, fumigant
Fensulfothion[2]	Dasanit	I, N
Fonofos[2]	Dyfonate	I, N
Isofenphos	Amaze, Oftanol	I
Oxamyl	DPX 1410, Vydate	I, N, Ac
Permethrin	Ambush, Pounce	I, Ac, N
Phenamiphos	Nemacur	N
Phorate[2]	Thimet	I, N, Ac
Phoxim	Baythion, Volaton	I
Propoxur	Baygon	I
Stirofos	Gardona, Rabon	I, Ac
Terbufos[2]	Counter	I
Thiofanox	Dacamox	I, Ac
Trichlorfon	Dylox, Dipterex	I
Trichloronate	Agritox	N, I

Numbered compounds	Chemical name	Trade name
BTS-34-778 (GCP-6361).	3-(1,1-dimethylethyl)-_N_,_N_-dimethyl-5-(methylthio)-1_H_-1,2,4-triazole-1-carboxamide	
CGA 12223 (isazophos-proposed).	_O_[5-chloro-1-(1-methylethyl)-1_H_-1,2,4-triazol-3-yl]_O_,_O_-diethyl phosphorothioate	Miral
ER-2441	_O_,_O_-diethyl _S_-1-propenyl phosphorodithioate	
GCP-9646	3-(1,1-dimethylethyl)-_N_,_N_-dimethyl-5-(2-propenylthio)-1_H_-1,2,4-triazole-1-carboxamide	

Table 1.--*Common names, trade names, and chemical names of materials mentioned in text and tables*--Continued

Common name	Chemical name	Trade name
N-2596	S-(p-chlorophenyl)O-ethyl ethanephosphonodithioate	
SD 8832	2-chloroethenyl ethyl diethylphosphoramidate	
UC-30045	methyl[2-(1-methylethyl)-4-[[(methylamino)-carbonyl]oxy]=phenyl]carbamate	
Experimental nematocide (3M Co.).	2,4-dimethyl-1,3-dithiolane-2-carboxaldehyde O-(methylcarbamoyl)oxime	Tirpate

[1] I = insecticide, Ac = acaracide, N = nematocide, F = fungicide. Where more than one is given, the major use is listed first.

[2] Currently registered for control of the sugarbeet root maggot.

[3] Currently registered for control of nematodes on sugarbeet.

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